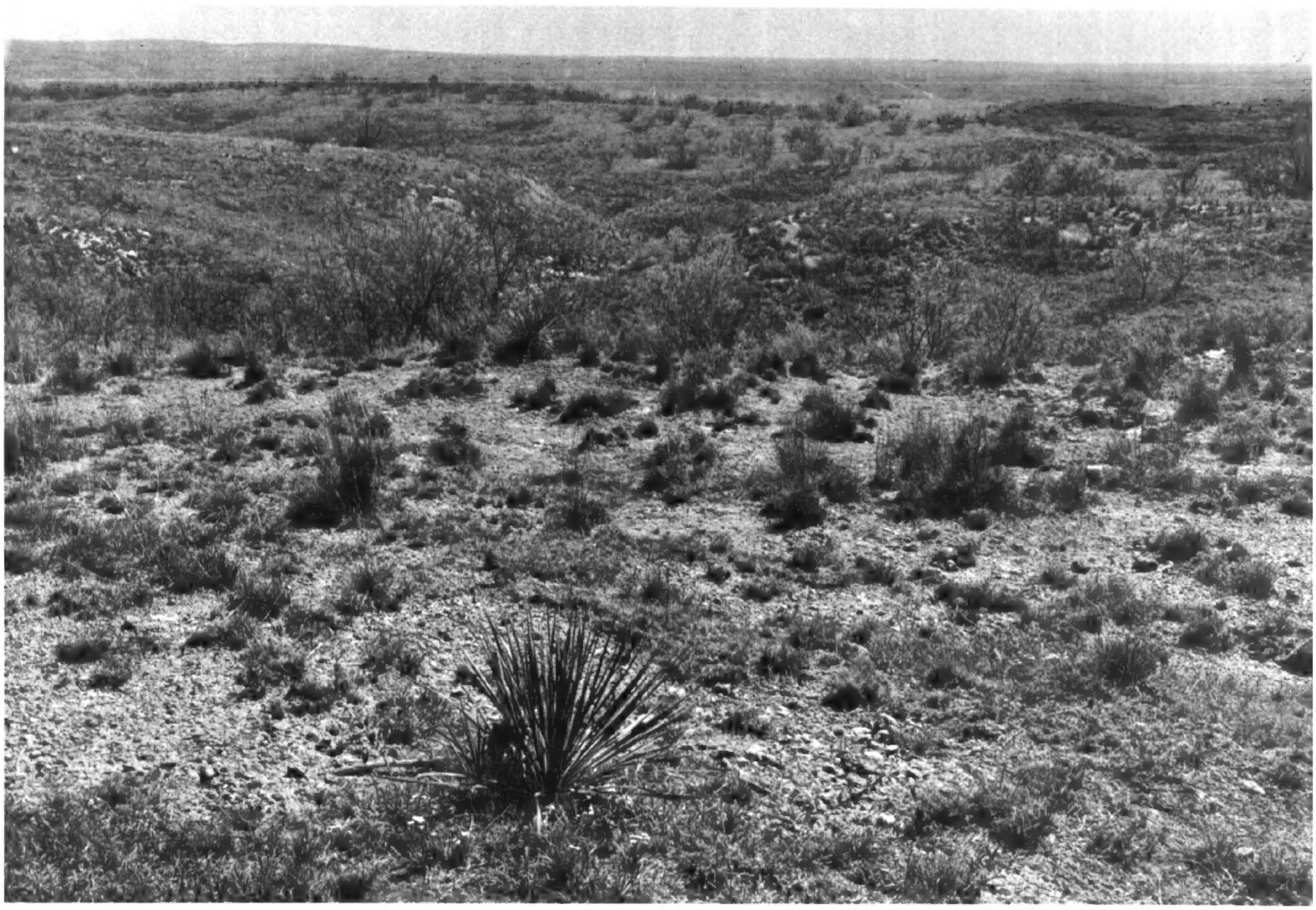
SOIL SURVEY OF

Collingsworth County, Texas



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station

Issued August 1973

Major fieldwork for this soil survey was done in the period 1959–64. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1965. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Salt Fork Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All of the soils of Collingsworth County are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with a number shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside, and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites and capability units.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation, Classification, and Morphology of the Soils."

Newcomers in Collingsworth County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the survey.

Cover picture: **Typical rangeland scene. The soils are of the Lutie-Quinlan-Cottonwood complex.**

U.S. GOVERNMENT PRINTING OFFICE: 1973

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Contents

Issued August 1973

SOIL SURVEY OF COLLINGSWORTH COUNTY, TEXAS

BY HARRY F. McEWEN, FRANKIE F. WHEELER, AND JACK C. WILLIAMS, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

COLLINGSWORTH COUNTY is located in the southeastern corner of the Texas Panhandle (fig. 1). Wellington, the county seat, is about 7 miles north of the Childress County line on U.S. Highway No. 83. The town serves a productive farming and livestock area.

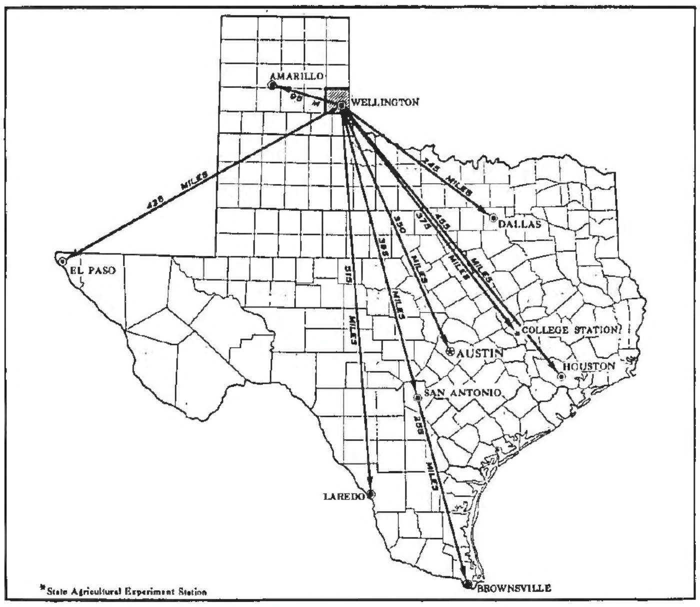


Figure 1.—Location of Collingsworth County in Texas.

In 1960, the population of the county was 6,276. At present, the population is decreasing slightly.

The county is about 30 miles square and has a total area of 905 square miles, or 579,200 acres. The principal farm enterprises are beef cattle, cotton, wheat, and grain sorghum. About 55 percent of the county is rangeland, 40 percent is cropland, and the rest is urban areas and water areas.

Collingsworth County is located in the Rolling Plains Land Resource Area. Most of the soils in the county formed under grass. They are dominantly dark-colored, loamy and sandy soils. Unless protected, all but the nearly level soils are susceptible to sheet and gully erosion. All the soils are subject to soil blowing if they are not protected.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Collingsworth County and how they can be used. They went into the county expecting to find many soils they had already seen, and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons between the profiles they studied. They compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* (*7*) [1] are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, the major horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. For example, Abilene and Colorado are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the natural, undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miles loamy fine sand, 0 to 3 percent slopes, is one of several phases within the Miles series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this survey was prepared from the aerial photographs.

[1] Italic numbers in parentheses refer to Literature Cited, p. 55.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or phase.

Some mapping units are made up of soils of different series or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Collingsworth County, soil complexes and undifferentiated soil groups.

A soil complex is a mapping unit that consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. The Ector-LaCasa complex is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated soil group consists of the names of the dominant soils, joined by "and." Miles and Altus soils, 0 to 1 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it is not feasible to classify the soil by series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rough broken land is a land type in Collingsworth County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Only part of a soil survey is complete when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that makes it readily useful to different groups of users, such as farmers, managers of rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial soil groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Collingsworth County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to those who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or other structure, because soils within an association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The five soil associations in Collingsworth County are discussed in the following pages. The terms for texture used in the title of the associations apply to the surface layer. For example, in the title for association 1 the word "loamy" refers to texture of the surface layer.

1. Woodward-Quinlan association

Shallow to moderately deep, loamy soils over weakly cemented sandstone

This association occupies large areas on dissected, gently sloping to steep uplands. It consists of moderately deep and shallow, calcareous, loamy soils formed in Permian red beds (fig. 2). The association is the largest in the county, and makes up about 30 percent of the total area.

The Woodward soils occupy about 30 percent of this association, and Quinlan soils about 20 percent. The remaining 50 percent is occupied by Lutie, Cottonwood, Ector, Colorado, Yahola, and Spur soils, and by Rough broken land.

The moderately deep Woodward soils are on ridge tops and in areas leading to natural drains. The shallow Quinlan soils are on convex ridges and knobs, in areas below the Woodward soils, and on the tops of small mesas.

The Woodward soils have a reddish-brown, calcareous loam surface layer about 8 inches thick. The next layer is reddish-yellow, calcareous very fine sandy loam that is about 19 inches thick and contains many fine concretions of calcium carbonate in the lower part. The underlying material is weakly cemented sandstone that begins at a depth of about 27 inches.

The Quinlan soils have a reddish-brown, calcareous loam surface layer about 5 inches thick. The next layer is very friable, calcareous, red very fine sandy loam about 9 inches thick. It is underlain by weathered Permian sandstone or packsand.

Almost all of this association is used for rangeland. If the soils are not protected, the hazard of soil blowing is slight and that of water erosion is moderate to severe. Available water capacity ranges from moderate to high.

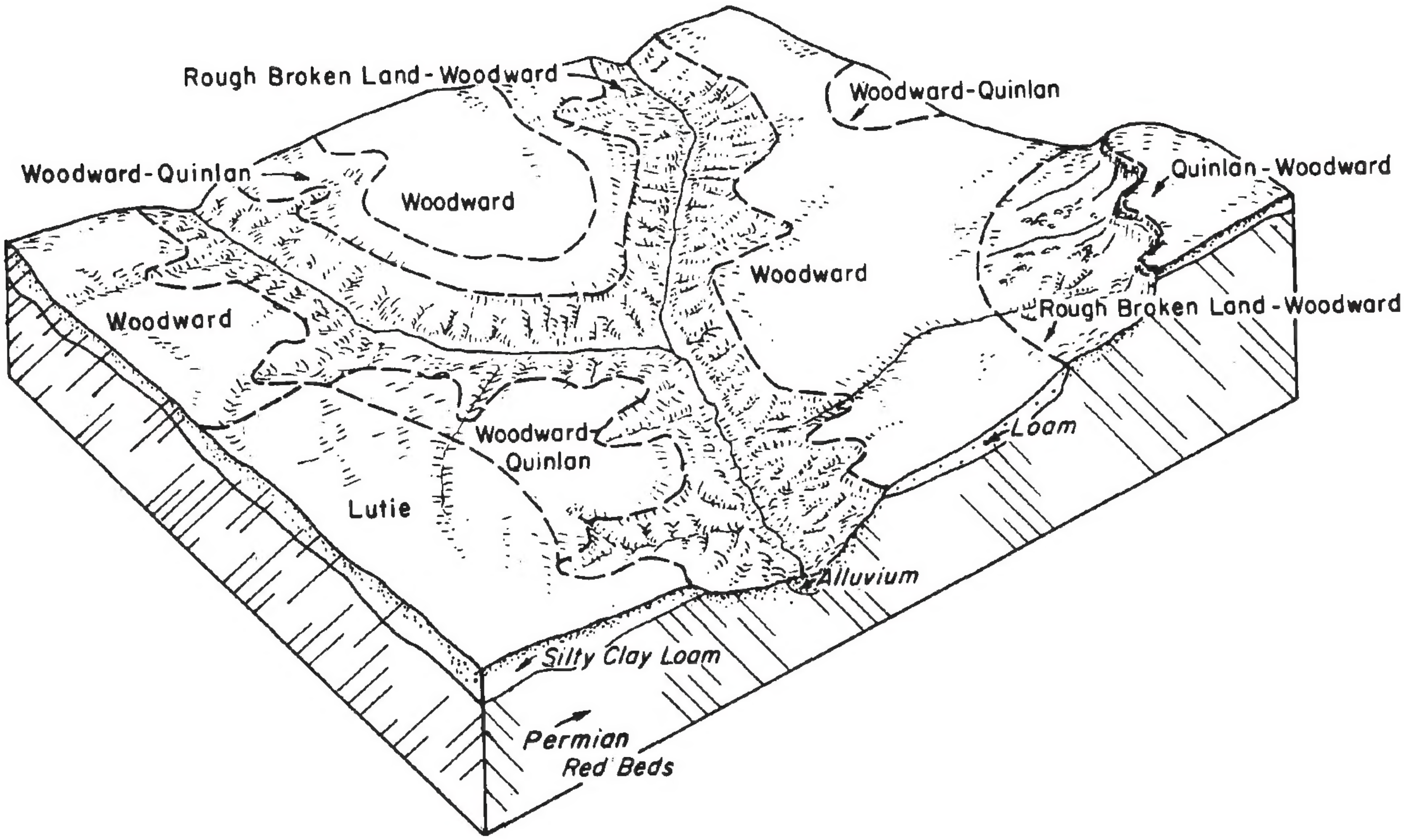


Figure 2.—An area typical of the Woodward-Quinlan association.

2. *Miles-Springer association*

Deep, nearly level to sloping, sandy soils

This association occupies undulating and hummocky areas. It consists of deep, noncalcareous, sandy soils that formed over outwash material (fig. 3). These soils have a dominantly loamy fine sand surface layer that is eroded in some places. This association makes up about 27 percent of the county.

The Miles soils occupy about 40 percent of the association, and Springer soils about 35 percent. Some areas of Springer fine sandy loams are included. The remaining 25 percent of the association consists of Brownfield, Nobscot, Tivoli, and Lincoln soils, and there are areas of Blown-out land closely intermingled with Springer and Brownfield soils.

The Miles soils are in the smoother parts of the association and are less sloping and less eroded than the Springer soils.

The Miles soils have a neutral, brown loamy fine sand surface layer about 14 inches thick. The next layer is about 50 inches thick and is firm, neutral sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is calcareous, pink sandy clay loam.

The Springer soils have a brown and reddish-brown loamy fine sand surface layer about 18 inches thick. The next layer is about 37 inches thick. It is yellowish-red fine sandy loam in the upper part and loamy fine sand in the lower part. The underlying material is reddish-yellow loamy fine sand.

The less sloping areas of Miles soils and Springer soils are cultivated. The more sloping and eroded areas of these soils, and the other soils in the association, are used for range.

The soils in this association are susceptible to soil blowing. The more sloping areas are moderately susceptible to water erosion. Available water capacity is moderate to high. The soils are well drained, and surface runoff is slow.

3. *Miles-Carey association*

Deep, nearly level to gently sloping, loamy soils

This association consists of deep, loamy soils that formed over Permian red beds (fig. 4). These soils have a loam or fine sandy loam surface layer and are eroded in a few places. The association makes up about 20 percent of the county.

The Miles soils make up about 45 percent of the association, and the Carey soils about 20 percent. The remaining 35 percent is small areas of Woodward, Wichita, Altus, Abilene, Enterprise, Mansker, and Yahola soils.

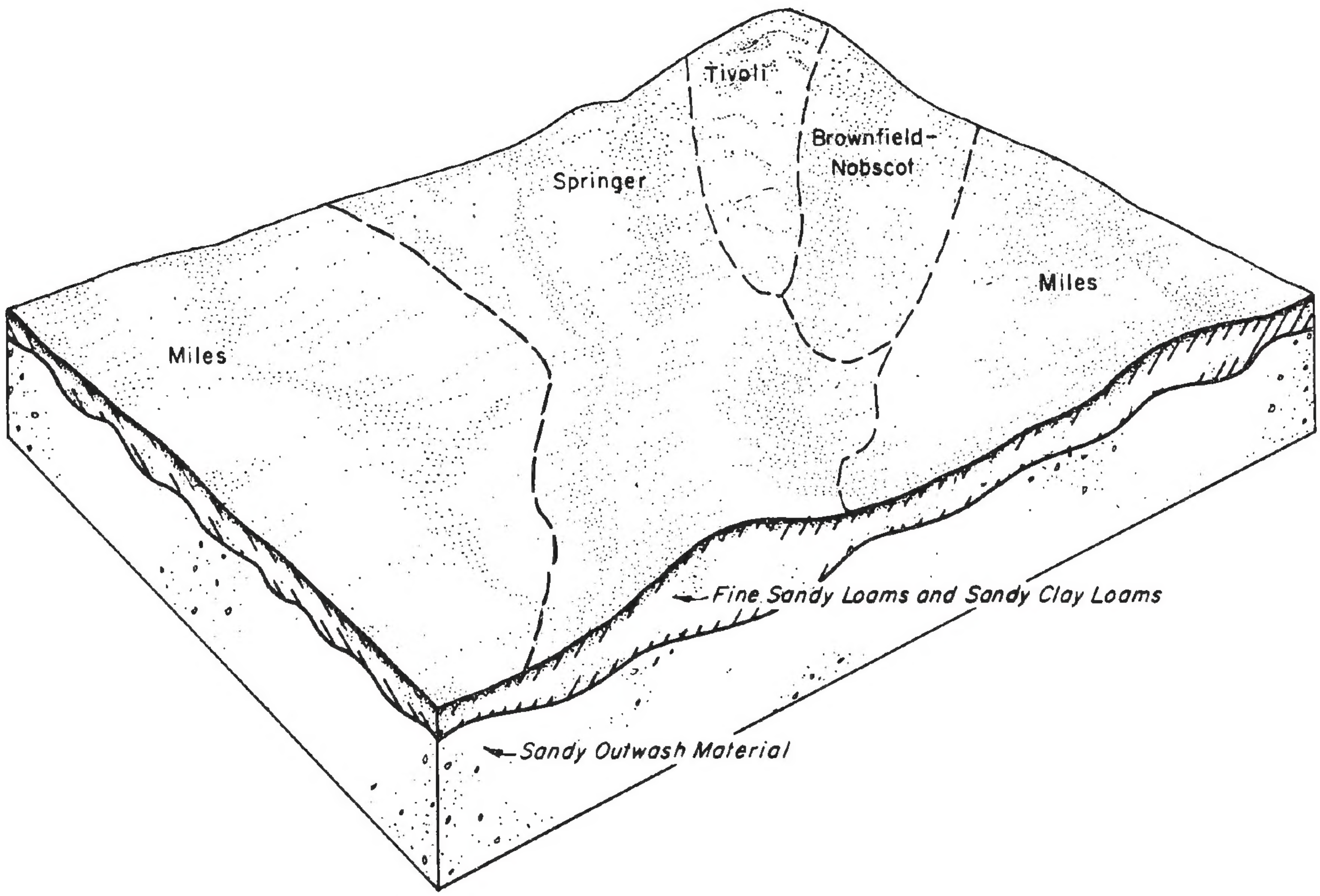


Figure 3.—An area typical of the Miles-Springer association.

The Miles soils are in smooth, broad areas and occupy slightly higher positions in the landscape than the Carey soils. The Carey soils are less sandy than the Miles soils, are on lower positions, and are closer to the drainageways.

The Miles soils have a neutral, dark-brown fine sandy loam surface layer about 10 inches thick. The next layer is sandy clay loam about 38 inches thick. It is reddish-brown in the upper part and yellowish-red in the lower part. The underlying material is yellowish-red fine sandy loam.

The Carey soils have a reddish-brown loam surface layer about 10 inches thick. The next layer is reddish-brown sandy clay loam in the upper 10 inches and is red very fine sandy loam in the lower 17 inches. The underlying material is light-red very fine sandy loam that contains about 5 percent visible calcium carbonate in the upper part.

Most of this association is cultivated. A few areas are irrigated. Some areas of the association are used for range.

If the soils are not protected, the hazards of soil blowing and of water erosion are slight to moderate. Available water capacity is high. The soils are well drained, and surface runoff is slow to moderate.

4. *Ector-LaCasa association*

Very shallow and deep, gently sloping to sloping, loamy soils

This association consists of very shallow and deep, loamy soils that formed over dolomitic limestone and Permian red beds (fig. 5). It covers about 12 percent of the county.

The Ector soils occupy about 35 percent of the association, and the LaCasa soils about 30 percent. The remaining 35 percent is small areas of Lutie, Cottonwood, Quinlan, Woodward, Colorado, and Spur soils.

The very shallow Ector soils are on the ridges. The deep LaCasa soils are adjacent to the Ector soils and are in concave, valleylike depressions and on intervening flats.

The Ector soils have a brown, calcareous gravelly loam surface layer that overlies fractured, platy dolomitic limestone at a depth of about 7 inches.

The LaCasa soils have a dark-brown, calcareous silty clay loam surface layer about 14 inches thick. The next layer is firm, calcareous clay loam, about 22 inches thick, that is brown in the upper part and light brown in the lower part. The underlying material, to a depth of 54

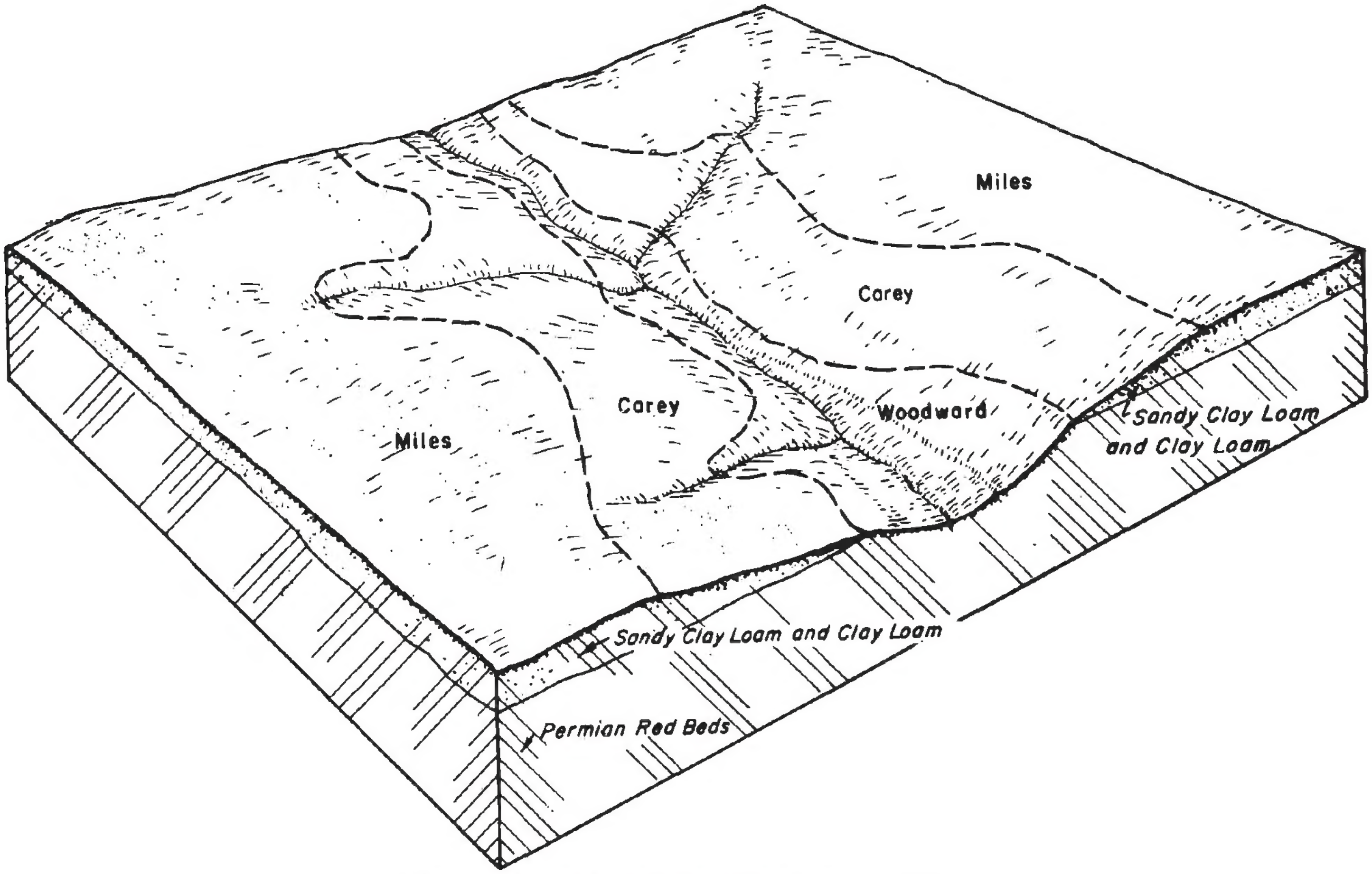


Figure 4.—An area typical of the Miles-Carey association.

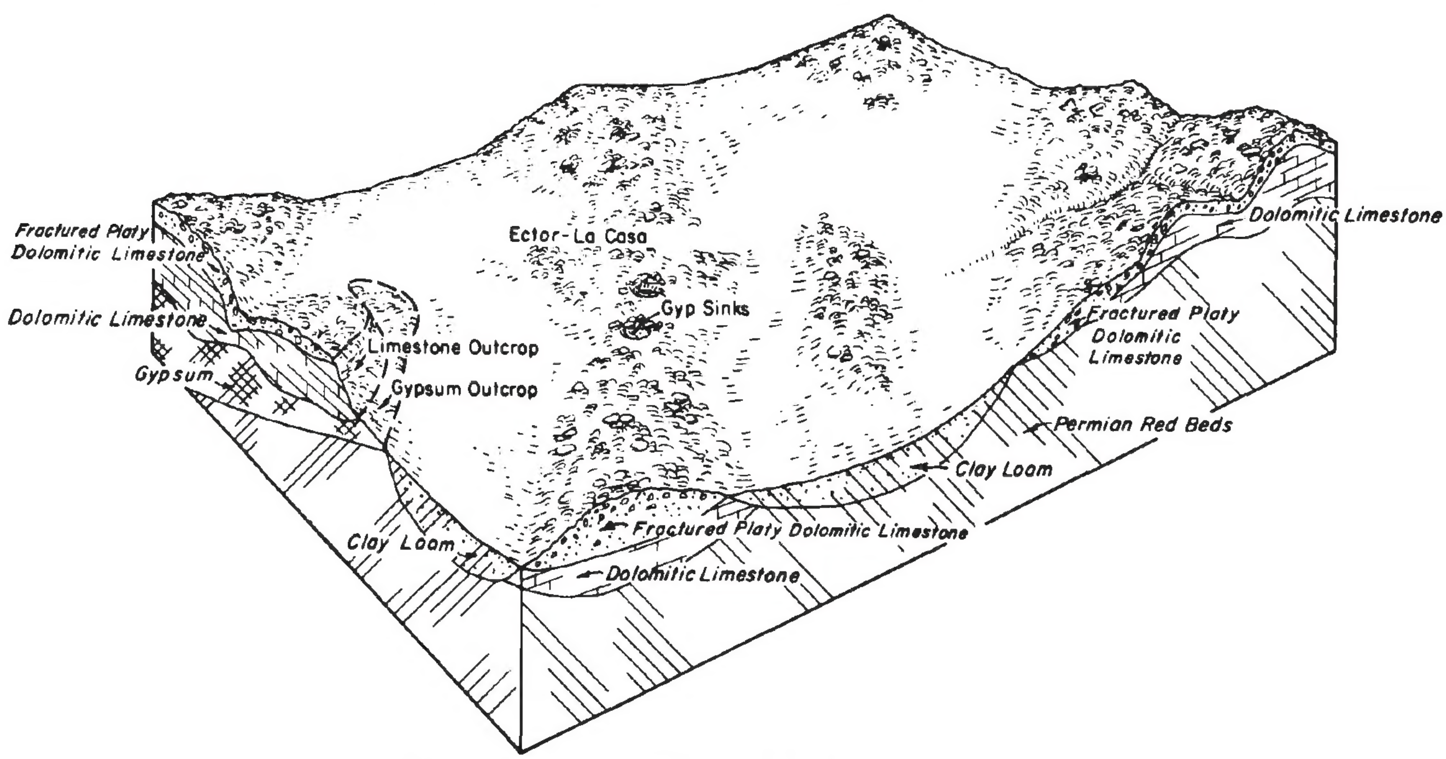


Figure 5.—An area typical of the Ector-LaCasa association.

inches, is pink clay loam that contains many small concretions of calcium carbonate. Below this, it is yellowish-red clay loam.

Most of this association is used for range. Some small areas are cultivated. The Ector, Cottonwood, and Quinlan soils are unsuitable for cultivation.

If the soils in this association are not protected, the hazard of soil blowing is slight and that of water erosion is moderate. The soils are well drained, and surface runoff is moderate to rapid. Available water capacity ranges from low to high.

5. *Wichita-Lutie association*

Deep, nearly level to sloping, loamy soils

This association consists of deep, loamy soils that formed over Permian red beds (fig. 6). It makes up about 11 percent of the total area of the county.

The Wichita soils and the Lutie soils each occupy about 40 percent of the association. The remaining 20 percent is made up of small areas of Woodward, Carey, Miles, LaCasa, Ector, Colorado, and Spur soils. Of these soils, the Woodward are the most extensive.

The deep Wichita soils generally are less sloping and less eroded than the Lutie soils. The Lutie soils are in areas leading to the natural drains and on small, oval-shaped knolls intermingled with Wichita soils.

The Wichita soils have a reddish-brown loam surface layer about 10 inches thick. The next layer is clay loam that extends to a depth of about 37 inches. It is reddish-brown and is noncalcareous in the upper part and calcareous in the lower part. Below this is calcareous clay loam that is yellowish red in the upper part and red in the lower part.

The Lutie soils have a reddish-brown, calcareous clay loam and silty clay loam surface layer about 12 inches thick. The next layer is firm silty clay loam. It is yellowish red and reddish brown to a depth of about 24 inches. Below this, it is red and contains lenses of shaly clay.

Most of this association is cultivated and in crops commonly grown in the county. Some small areas of the association are used for range.

If the soils are not protected, the hazard of soil blowing is slight and that of water erosion is moderate. Available water capacity is high. The soils are well drained, and surface runoff is slow to moderate.

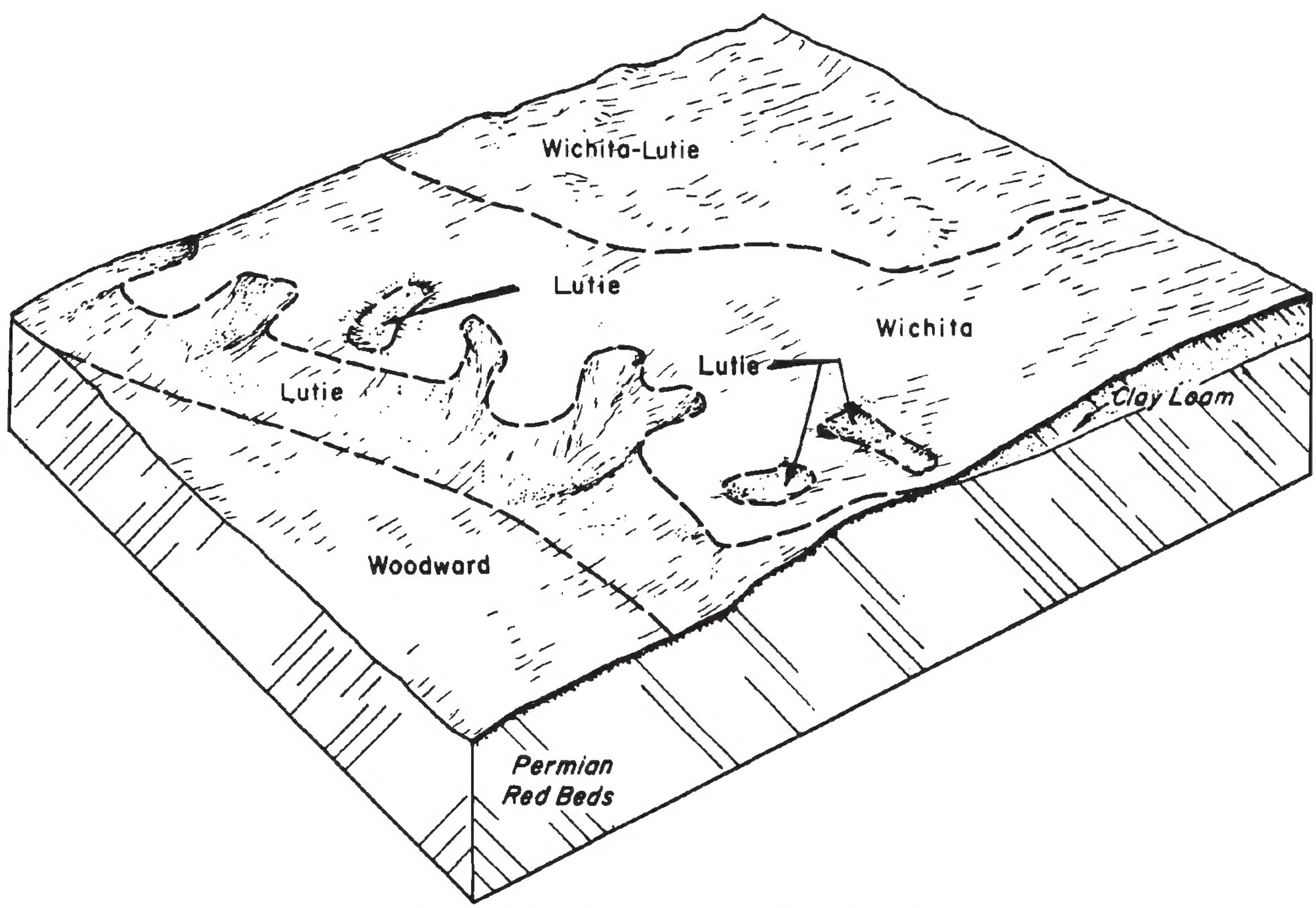


Figure 6.—An area typical of the Wichita-Lutie association.

Descriptions of the Soils

This section describes the soil series and mapping units of Collingsworth County. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

In the pages that follow, a general description of each soil series is given. Each series description has a short narrative description of a representative profile and a much more detailed description of the same profile, from which highly technical interpretations can be made. Following the profile is a brief statement of the range in characteristics of the soils in the series as mapped in this county. Following the series description, each mapping unit in the series is described individually. For full information on any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit. Miscellaneous land types, such as Rough broken land, are described in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. At the end of the description of each mapping unit are listed the capability unit and the range site in which the mapping unit has been placed. The page where each of these groups is described can be found readily by referring to the "Guide to Mapping Units" at the back of this publication.

For more general information about the soils, the reader can refer to the section "General Soil Map," in which the broad patterns of soils are described. Many of the terms used in the soil descriptions and other parts of the survey are defined in the Glossary.

Soil colors in the following descriptions are Munsell color notations for dry soil unless specified as moist.

Abilene Series

The Abilene series consists of deep, neutral, loamy soils that are well drained and moderately slowly permeable. These soils are nearly level to gently sloping and are on uplands.

In a representative profile, the surface layer is dark grayish-brown clay loam about 9 inches thick. The next layer, about 27 inches thick, is dark-brown silty clay loam in the upper 5 inches and brown silty clay loam in the lower part. The underlying material, to a depth of 60 inches, is pale-brown clay loam that contains about 15 percent visible calcium carbonate ranging from films and threads to concretions.

Abilene soils have a high available water capacity. Runoff is slow.

Representative profile of Abilene clay loam, 0 to 1 percent slopes, in a cultivated field 100 feet west of county road, from a point 2,700 feet north of its intersection with Farm Road 338, which is about 4.0 miles southeast of the intersection of Farm Road 338 and U.S. Highway No. 83 in Wellington:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; slightly hard, friable; neutral; abrupt, smooth boundary.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Abilene clay loam, 0 to 1 percent slopes	1, 605	0. 3
Abilene clay loam, 1 to 3 percent slopes	1, 240	. 2
Brownfield-Nobscot fine sands	8, 508	1. 5
Carey loam, 0 to 1 percent slopes	5, 229	. 9
Carey loam, 1 to 3 percent slopes	18, 815	3. 3
Carey loam, 3 to 5 percent slopes	2, 177	. 4
Colorado loam	3, 205	. 5
Ector-LaCasa complex	63, 734	11. 0
Enterprise very fine sandy loam, 1 to 3 percent slopes	736	. 1
Enterprise very fine sandy loam, 3 to 5 percent slopes	467	([1])
Enterprise very fine sandy loam, 5 to 12 percent slopes	2, 410	. 4
LaCasa silty clay loam, 1 to 3 percent slopes	6, 206	1. 1
LaCasa silty clay loam, 3 to 5 percent slopes	1, 092	. 2
Lincoln soils	9, 550	1. 6
Lutie clay loam, 1 to 3 percent slopes	2, 814	. 5
Lutie clay loam, 3 to 6 percent slopes	5, 913	1. 0
Lutie-Quinlan-Cottonwood complex	35, 632	6. 2
Mansker fine sandy loam, 1 to 3 percent slopes	757	. 1
Mansker fine sandy loam, 3 to 5 percent slopes	3, 070	. 5
Mansker fine sandy loam, 5 to 8 percent slopes	1, 788	. 3
Mansker-Woodward complex	14, 945	2. 6
Miles and Altus soils, 0 to 1 percent slopes	9, 292	1. 6
Miles fine sandy loam, 1 to 3 percent slopes	39, 993	6. 9
Miles fine sandy loam, 3 to 5 percent slopes	5, 878	1. 0
Miles fine sandy loam, 3 to 5 percent slopes, eroded	1, 419	. 2
Miles loamy fine sand, 0 to 3 percent slopes	57, 819	10. 0
Miles loamy fine sand, 3 to 5 percent slopes	4, 205	. 7
Miles soils, severely eroded	6, 918	1. 2
Quinlan-Woodward loams	75, 114	13. 0
Rough broken land-Woodward complex	3, 831	. 7
Springer fine sandy loam, 3 to 5 percent slopes	5, 120	. 9
Springer fine sandy loam, 5 to 8 percent slopes	12, 861	2. 2
Springer loamy fine sand, undulating	7, 761	1. 3
Springer loamy fine sand, hummocky	24, 372	4. 2
Springer-Brownfield-Blown-out land complex	16, 460	2. 8
Spur clay loam	4, 531	. 8
Spur and Colorado soils	3, 763	. 6
Tivoli fine sand	9, 853	1. 7
Wichita loam, 0 to 1 percent slopes	8, 029	1. 4
Wichita loam, 1 to 3 percent slopes	3, 841	. 7
Wichita-Lutie loams, 0 to 2 percent slopes	18, 306	3. 2
Wichita-Lutie loams, 2 to 6 percent slopes	5, 554	1. 0
Wichita-Lutie loams, 2 to 6 percent slopes, eroded	680	. 1
Woodward loam, 1 to 3 percent slopes	10, 282	1. 9
Woodward loam, 3 to 5 percent slopes	9, 762	1. 7
Woodward-Quinlan loams, 2 to 5 percent slopes	9, 863	1. 7
Woodward-Yahola-Breaks complex	26, 220	4. 5
Yahola fine sandy loam	3, 077	. 5
Other land, river channels, and water areas	4, 503	. 8
Total	579, 200	100. 0

[1] Less than 0.1 percent.

B1—9 to 14 inches, dark-brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, subangular blocky structure; slightly hard, friable; few fine pores; thin, discontinuous clay films on ped surfaces; neutral; clear, smooth boundary.

B2t—14 to 26 inches, brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, blocky structure; very hard, very firm; thin, continuous clay films on ped surfaces; neutral; clear, smooth boundary.

B3—26 to 36 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard, very firm; few films, threads, and small, strongly cemented concretions of calcium carbonate; calcareous, moderately alkaline; gradual, wavy boundary.

Cca—36 to 60 inches +, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; slightly hard, friable; contains films, threads, soft masses, and small, strongly cemented concretions of calcium carbonate, visibly comprising about 15 percent by volume; calcareous, moderately alkaline.

The A horizon ranges from 7 to 10 inches in thickness. Its color ranges from grayish brown to dark brown. The B horizon ranges in thickness from 20 to 38 inches and in texture from silty clay loam to clay. Depth to the Cca horizon is 28 to 48 inches. Visible calcium carbonate in the Cca horizon is about 5 to 25 percent, by volume.

Abilene clay loam, 0 to 1 percent slopes (AbA).—This nearly level soil is on uplands. Slopes are smooth. Areas average about 50 acres in size, but some are as large as 400 acres. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Wichita loam, Carey loam, Altus fine sandy loam, and Miles fine sandy loam. These included soils make up less than 6 percent of any given area.

Most of this soil is cultivated; the rest is used for pasture or range. (Capability unit IIce-4; Deep Hardland range site)

Abilene clay loam, 1 to 3 percent slopes (AbB).—This gently sloping soil is on uplands. Areas average about 30 acres in size, but some are as large as about 200 acres. In a few areas the surface layer is eroded and contains rills. The rills can be smoothed by cultivation.

The dark grayish-brown, neutral clay loam surface layer is about 7 inches thick. The next layer is brown silty clay loam that is limy in the lower part. The underlying material of pale-brown clay loam is at a depth of about 30 inches and contains about 20 percent visible calcium carbonate.

Included with this soil in mapping are small areas of Wichita loam, Carey loam, and Miles fine sandy loam. Included soils make up less than 8 percent of any given area.

Most of this soil is cultivated; the rest is used for range. (Capability unit IIIe-2; Deep Hardland range site)

Altus Series

The Altus series consists of deep, well-drained loamy soils that are moderately permeable and nearly level.

In a representative profile, the surface layer is dark grayish-brown to dark-brown fine sandy loam about 20 inches thick. The next layer is firm sandy clay loam. It is dark grayish brown in the upper 16 inches and calcareous and strong brown in the lower 12 inches. The underlying material, to a depth of 64 inches, is reddish-yellow very fine sandy loam. In the upper 14 inches, this material contains about 3 percent visible calcium carbonate ranging from films and threads to concretions.

Soil blowing is a moderate hazard. Available water capacity is high.

In Collingsworth County the Altus soils were mapped only in an undifferentiated group with the Miles soils.

Representative profile of an Altus fine sandy loam in an area of Miles and Altus soils, 0 to 1 percent slopes, in a cultivated field 1,400 feet east of U.S. Highway No. 83, from a point 5,380 feet north of its intersection with State Highway 203 in Wellington:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, granular structure; slightly hard, friable; neutral; abrupt, smooth boundary.

A1—8 to 20 inches, dark-brown (10YR 3/3) fine sandy loam, very dark brown (10YR 2/3) when moist; weak, subangular blocky structure; hard, friable; common fine pores; neutral; clear, smooth boundary.

B2t—20 to 36 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; very hard, firm; distinct, discontinuous clay films on ped surfaces; neutral; gradual, smooth boundary.

B3—36 to 48 inches, strong-brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 4/6) when moist; weak, subangular blocky structure; hard, firm; few films and threads of calcium carbonate; calcareous, moderately alkaline; clear, wavy boundary.

C1ca—48 to 62 inches, reddish-yellow (5YR 7/6) very fine sandy loam, yellowish red (5YR 5/6) when moist; slightly hard, friable; about 3 percent films, threads, and small, weakly cemented concretions of calcium carbonate; calcareous, moderately alkaline; diffuse, wavy boundary.

C2—62 to 64 inches +, reddish-yellow (5YR 7/6) very fine sandy loam, yellowish red (5YR 5/6) when moist; contains soft red packsand; calcareous, moderately alkaline.

The A horizon ranges from 8 to 25 inches in thickness. Its color ranges from grayish brown to dark brown. The B horizon ranges from 24 to 45 inches in thickness and from fine sandy loam to sandy clay loam in texture. Its color is grayish brown to strong brown. Depth to the C1ca horizon ranges from 32 to 70 inches.

Brownfield Series

The Brownfield series consists of deep, sandy soils that are well-drained and moderately permeable. These soils are gently sloping to sloping and are on uplands.

In a representative profile, the surface layer is a brown fine sand about 7 inches thick. Below this layer is pink fine sand about 17 inches thick. The next layer is red sandy clay loam about 38 inches thick. The underlying material to a depth of about 66 inches is friable red sandy loam.

The hazard of soil blowing is severe, and that of water erosion is slight. Runoff is slow. Available water capacity is low.

Representative profile of Brownfield fine sand in an area of Brownfield-Nobscot fine sands in a native range, 3,168 feet north of county road, from a point 1.6 miles east of its intersection with Farm Road 1547, which is about 6.0 miles north of the intersection of Farm Road 1547 and Farm Road 1036 in Dozier:

A1—0 to 7 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; single grain (structureless); loose when dry or moist; slightly acid; clear, smooth boundary.
A2—7 to 24 inches, pink (7.5YR 7/4) fine sand, brown (7.5YR 5/4) when moist; single grain (structureless); loose when dry or moist; slightly acid; clear, smooth boundary.
B2t—24 to 62 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) when moist; weak, very coarse, prismatic structure; very hard, friable; nearly continuous clay films on vertical faces of prisms; neutral; gradual, wavy boundary.
C—62 to 66 inches +, red (2.5YR 5/6) sandy loam, red (2.5YR 4/6) when moist; massive (structureless); hard, friable; neutral.

The A1 horizon ranges from 5 to 8 inches in thickness and is reddish brown to brown when dry. The A2 horizon ranges from 12 to 30 inches in thickness and from light reddish brown to pink. The B2t horizon is 20 to 40 inches thick and fine sandy loam to sandy clay loam. Its color is red to reddish brown or yellowish red. Clay content of the B2t horizon ranges from 18 to 30 percent. Depth to C horizon ranges from 60 to 76 inches. Texture of the C horizon is fine sandy loam to loamy fine sand.

Brownfield-Nobscot fine sands (Bn).—These soils are gently sloping to sloping on uplands. They are in areas that average about 300 acres in size, but a few areas are as large as 1,200 acres. Slopes range from about 3 to 8 percent and average about 4 percent. The surface is undulating to hummocky, and there are some dunes.

About 65 percent of this complex is Brownfield fine sand, and about 30 percent is Nobscot fine sand. The Brownfield and Nobscot soils are in similar positions in the landscape. They are in such an intricate pattern that separation is not practical.

Included with these soils in mapping are small areas of Springer loamy fine sand, Miles loamy fine sand, and Tivoli fine sand that make up 5 percent of the acreage.

The hazard of soil blowing makes the soils in this mapping unit unsuitable for cultivation. They are used almost entirely for range.

These soils need careful management to control soil blowing. In some places, fence rows have an accumulation of fine sand from 3 to more than 20 feet deep. Many areas were once cultivated but have been seeded to adapted grasses. (Capability unit VIe-7; Deep Sand range site)

Carey Series

The Carey series consists of deep, mildly alkaline, loamy soils that are well drained and moderately permeable. These soils are nearly level to gently sloping and are on uplands.

In a representative profile, the surface layer is reddish-brown loam about 10 inches thick. The next layer is reddish-brown sandy clay loam in the upper 10 inches and red very fine sandy loam in the lower 17 inches. The underlying material, to a depth of 90 inches, is light-red very fine sandy loam. It contains about 5 percent visible calcium carbonate, ranging from films and threads to soft masses, in the upper 23 inches.

These soils have slow to medium runoff. Available water capacity is high.

Representative profile of Carey loam, 1 to 3 percent slopes, in a cultivated field 100 feet north of county road, from a point 4,780 feet east of its intersection with U.S. Highway No. 83, which is about 6.0 miles south of the intersection of U.S. Highway No. 83 and Farm Road 338 in Wellington:

Ap—0 to 10 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) when moist; weak, granular structure; soft, very friable; mildly alkaline; abrupt, smooth boundary.
B2t—10 to 20 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; weak, medium, subangular blocky structure; hard, firm; contains much very fine sand and silt; thin, discontinuous clay films on ped surfaces; mildly alkaline; gradual, wavy boundary.
B3—20 to 37 inches, red (2.5YR 5/6) very fine sandy loam, dark red (2.5YR 3/6) when moist; weak, subangular blocky structure; slightly hard, friable; mildly alkaline; gradual, wavy boundary.
C1ca—37 to 60 inches, light-red (2.5YR 6/8) very fine sandy loam, red (2.5YR 4/8) when moist; slightly hard, friable; about 5 percent films, threads, and soft masses of calcium carbonate; calcareous, moderately alkaline; gradual, wavy boundary.
C2—60 to 90 inches +, light-red (2.5YR 6/8) very fine sandy loam, red (2.5YR 4/8) when moist; weak, subangular blocky structure; soft, very friable; calcareous, moderately alkaline.

The A horizon ranges from 8 to 16 inches in thickness. Its color ranges from reddish gray to reddish brown. The B horizon ranges from 16 to 32 inches in thickness and from sandy clay loam to clay loam or silty clay loam in texture. Depth to the C1ca horizon is 24 to 48 inches. Visible calcium carbonate in the C1ca horizon is 1 to about 10 percent, by volume.

Carey loam, 0 to 1 percent slopes (CaA).—This nearly level soil is on uplands. Slopes are smooth. Areas range from 10 to 250 acres in size, but average about 40 acres.

The reddish-brown loam surface layer is about 14 inches thick. The next layer is reddish-brown sandy clay loam that changes gradually to red very fine sandy loam in the lower part. The underlying material is light-red very fine sandy loam, is at a depth of about 46 inches, and contains about 2 percent, by volume, visible calcium carbonate in the upper 20 inches.

Included with this soil in mapping are small areas of Woodward loam, Wichita loam, Abilene clay loam, Miles fine sandy loam, and Altus fine sandy loam. Inclusions make up less than 6 percent of any given area.

This soil is used for crops and is suited to all crops grown in the county. (Capability unit IIce-2; Mixedland range site)

Carey loam, 1 to 3 percent slopes (CaB).—This gently sloping soil is in convex upland areas leading to natural drains. Areas are irregularly shaped and average about 250 acres in size, but some are as large as 500 acres.

This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Woodward loam, Wichita loam, Abilene clay loam, and Miles fine sandy loam. Included soils make up less than 8 percent of any given area.

Most of this soil is used for crops. (Capability unit IIe-1; Mixedland range site)

Carey loam, 3 to 5 percent slopes (CaC).—This gently sloping soil is on convex upland ridges. Areas are irregularly shaped and average about 20 acres in size, but some are as large as 80 acres.

The reddish-brown loam surface layer is about 8 inches thick. The next layer is about 18 inches thick and is firm, reddish-brown sandy clay loam that changes gradually to

red very fine sandy loam in the lower part. The underlying material is light-red very fine sandy loam; it contains about 10 percent, by volume, visible calcium carbonate in the upper 22 inches. In some areas the surface layer is eroded and contains rills and gullies. The rills can be smoothed by cultivation.

Included with this soil in mapping are small areas of Lutie clay loam, Woodward loam, Wichita loam, and Miles fine sandy loam. Inclusions make up less than 10 percent of any given area.

About 50 percent of the acreage of this soil is used for crops, and the rest for pasture or range (fig. 7). (Capability unit IIIe–3; Mixedland range site)

Colorado Series

The Colorado series consists of deep, well-drained, friable, calcareous, loamy soils that have bedding planes. These soils are on flood plains of the major streams and their tributaries.

In a representative profile, the surface layer is reddish-brown loam about 10 inches thick. The underlying material, to a depth of 60 inches, is reddish-brown loam that has bedding planes and contains thin strata of clay loam and silt loam.

These soils are moderately permeable. Available water capacity is high.

Representative profile of Colorado loam in a field, 1,584 feet south of State Highway 203 and 792 feet west of Salt Fork of Red River, from a point 8.8 miles northeast of intersection of that highway with U.S. Highway No. 83 in Wellington:

A1—0 to 10 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) when moist; weak, fine, granular structure; soft, friable; calcareous, moderately alkaline; clear, smooth boundary.

C—10 to 60 inches +, reddish-brown (5YR 5/4) loam and thin strata and lenses of clay loam and silt loam; dark reddish brown (5YR 3/4) when moist; weak, thin, platy structure, related to evident bedding planes; slightly hard, friable; few worm casts and pores; calcareous, moderately alkaline.

The A horizon ranges from 4 to 15 inches in thickness and is light reddish brown to brown when dry. Content of clay at depths between 10 and 40 inches ranges from about 18 to 35 percent, and more than 15 percent of the material between these depths is coarser than very fine sand. The C horizon contains strata of clay loam, silt loam, and very fine sandy loam. Ranges in color of the C horizon are the same as those for the A horizon.

Figure 7.—New terraces being constructed in an area of Carey loam, 3 to 5 percent slopes.

Colorado loam (Co).—This nearly level soil is on flood plains of the major streams and their tributaries. Slopes average about 0.4 percent but range to about 1.0 percent. Areas are oblong and have smooth boundaries; they average about 60 acres in size, but some areas are as large as 150 acres.

Included with this soil in mapping are small areas of Spur clay loam, Yahola fine sandy loam, and Lincoln soils that make up less than 5 percent of any given area.

This soil is used mainly for cropland. It erodes if it is not protected, and runoff from higher adjacent slopes causes shallow rills. This soil is flooded about once in every 5 to 10 years, but floodwater remains on the surface less than about 24 hours. (Capability unit IIce–3; Loamy Bottomland range site)

Cottonwood Series

The Cottonwood series consists of well-drained, very shallow, loamy soils that are calcareous and are underlain by chalky gypsite. These soils are sloping to moderately steep and are on uplands.

In a representative profile, the surface layer is pale-brown, calcareous loam about 8 inches thick. Below this is calcareous, soft, chalky gypsite that becomes hard at a depth of about 18 inches.

These soils have a low available water capacity and moderate permeability. The hazard of soil blowing is slight, and that of water erosion is moderate.

In Collingsworth County the Cottonwood soils were mapped only in a complex with Lutie and Quinlan soils. This complex is described under the Lutie series.

Representative profile of a Cottonwood loam in an area of Lutie-Quinlan-Cottonwood complex in a native range, 1,584 feet west of county road, from a point 8.5 miles north of its intersection with Farm Road 1439, which is about 3.0 miles east of the intersection of Farm Road 1439 and U.S. Highway No. 83 in Lutie:

A1—0 to 8 inches, pale-brown (10YR 6/3) loam, brown (10YR 4/3) when moist; weak, granular structure; soft, friable; calcareous, moderately alkaline; abrupt, smooth boundary.

R—8 to 18 inches, white (10YR 8/2), chalky gypsite that becomes hard at a depth of 18 inches; no evidence of root penetration; calcareous, moderately alkaline.

The A horizon ranges from 3 to 10 inches in thickness and is light gray to reddish brown. The amount of calcium carbonate ranges from about 5 to 30 percent. Hardness of the R layer ranges from 1 to about 2.5 on Moh's scale.

Ector Series

The Ector series consists of very shallow, well-drained, loamy soils that are calcareous and are underlain by dolomitic limestone (fig. 8). These soils are gently sloping to sloping and are on uplands.

In a representative profile, the surface layer is brown gravelly loam about 7 inches thick. Below this is fractured, platy dolomitic limestone.

Figure 8.—**Profile of Ector gravelly loam. The brown gravelly loam surface layer is about 7 inches thick over fractured, platy, dolomitic limestone.**

These soils have a low available water capacity. Permeability is moderate. The hazard of soil blowing is slight and that of water erosion is moderate.

Representative profile of an Ector gravelly loam in an area of Ector-LaCasa complex in native range, 85 feet north of county road, from a point 2.83 miles east of its intersection with U.S. Highway No. 83, which is about 2.0 miles south of the intersection of U.S. Highway No. 83 and Farm Road 1439 in Lutie:

A1—0 to 7 inches, brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) when moist; weak, granular structure; soft, friable; contains about 55 percent limestone fragments that are mostly 1/2 to 10 inches across the long axis; calcareous, moderately alkaline; abrupt, irregular boundary.

R—7 to 20 inches +, fractured, platy dolomitic limestone with caliche coatings ranging in thickness from 5 to 20 millimeters; calcareous, moderately alkaline.

The A horizon ranges from 4 to 10 inches in thickness and is light brownish gray to brown. Content of limestone fragments in the A horizon ranges from 50 to about 65 percent, by volume. In some places the R layer contains thin layers of soft caliche. Hardness of the dolomitic limestone in the R layer ranges from 1 to about 3 on Moh's scale.

Ector-LaCasa complex (El).—The soils in this complex are gently sloping to sloping and are on uplands. Their surface is rolling, and slopes are both concave and convex. Slopes average about 3 percent. Areas average about 900 acres in size, but some areas are as large as 5,000 acres.

About 50 percent of the complex is Ector soils on convex ridges. About 30 percent of the complex is LaCasa soils that are in concave, valleylike depressions and on intervening flats.

Small included areas of Lutie clay loam, Wichita loam, Quinlan loam, Cottonwood loam, Woodward loam, and gypsum and limestone outcrops make up about 20 percent of this complex. Also included in this unit are holes, or gyp sinks, that have formed in areas of gypsum. In some places runoff water drains into the gyp sinks.

The soils in this complex are used mainly for range. (Capability unit VIIs-1; Ector soils, Very Shallow range site; LaCasa soils, Deep Hardland range site)

Enterprise Series

Soils of the Enterprise series are deep, well drained, very friable, calcareous, and loamy. These soils have little horizon development. They are gently sloping to strongly sloping and are on uplands.

In a representative profile, the surface layer is reddish-brown very fine sandy loam about 24 inches thick. The next layer, to a depth of about 52 inches, is yellowish-red, calcareous very fine sandy loam.

These soils have slow to medium runoff. Permeability is moderately rapid. Available water capacity is high.

Representative profile of Enterprise very fine sandy loam, 3 to 5 percent slopes, 1.25 miles north of the west end of State Highway 203 bridge over the Salt Fork of the Red River, the bridge being 9 miles east of intersection of U.S. Highway No. 83 and State Highway 203 in Wellington:

A1—0 to 24 inches, reddish-brown (5YR 4/3) very fine sandy loam, dark reddish brown (5YR 3/3) when moist; weak, granular structure; soft, very friable; calcareous, moderately alkaline; clear, smooth boundary.

B2—24 to 52 inches +, yellowish-red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) when moist; weak, granular structure; soft, very friable; common films and threads of calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges from 15 to 30 inches in thickness and is light reddish brown to brown. Organic-matter content of the A horizon ranges from 0.5 to 1 percent. The B2 horizon ranges from reddish brown to reddish yellow in color and from very fine sandy loam to loam in texture.

Enterprise very fine sandy loam, 1 to 3 percent slopes (EnB).—This gently sloping soil is on uplands. Slopes are smooth. Areas are from 10 to 50 acres in size, but they average about 25 acres.

The reddish-brown very fine sandy loam surface layer is about 30 inches thick and contains free lime. The next layer is very friable, yellowish-red very fine sandy loam that also contains free lime.

Included with this soil in mapping are small areas of Woodward loam and Springer loamy fine sand that make up less than 6 percent of any given area.

Most areas of this soil are cultivated; the rest is used for pasture or range. (Capability unit IIe-1; Mixedland range site)

Enterprise very fine sandy loam, 3 to 5 percent slopes (EnC).—This gently sloping soil is on uplands. Slopes are slightly convex. Areas range from 10 to 70 acres, but they average about 20 acres.

This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Woodward loam and Springer loamy fine sand that make up less than 8 percent of any given area.

Most areas of this soil are used for range. (Capability unit IIIe-3; Mixedland range site)

Enterprise very fine sandy loam, 5 to 12 percent slopes (EnD).—This sloping to strongly sloping soil is on uplands. It is on rolling, convex ridges and areas leading to the natural drains. Areas of this soil are irregularly shaped; they average about 100 acres in size, but some are as large as 200 acres.

The reddish-brown very fine sandy loam surface layer is about 16 inches thick and contains free lime. The next layer is very friable, yellowish-red very fine sandy loam that also contains free lime.

Included with this soil in mapping are small areas of Woodward loam, Springer loamy fine sand, and Tivoli fine sand. Included soils make up less than 10 percent of any given area.

This soil is used for range. Strong slopes and the hazard of erosion make it unsuitable for cultivation. (Capability unit VIe–4; Mixedland range site)

LaCasa Series

The LaCasa series consists of deep, well-drained, calcareous, moderately slowly permeable, loamy soils. These soils are gently sloping and are on uplands.

In a representative profile, the surface layer is dark-brown silty clay loam about 14 inches thick. The next layer is brown, firm clay loam in the upper 10 inches and light-brown clay loam in the lower 12 inches. The underlying material in the upper 18 inches is pink clay loam that has a high content of calcium carbonate. Below this, to a depth of 72 inches, it is yellowish-red clay loam.

The hazard of soil blowing is only slight, but that of water erosion is moderate. Runoff is medium. Available water capacity is high.

Representative profile of LaCasa silty clay loam, 1 to 3 percent slopes, in a cultivated field 50 feet west of county road, from a point 5,880 feet south of its intersection with Farm Road 1439, which is 3.0 miles east of the intersection of Farm Road 1439 and U.S. Highway No. 83 in Lutie:

Ap—0 to 6 inches, dark-brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) when moist; weak, subangular blocky structure; slightly hard, friable; calcareous, moderately alkaline; abrupt, smooth boundary.

A1—6 to 14 inches, dark-brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, subangular blocky structure; hard, firm; calcareous, moderately alkaline; clear, smooth boundary.

B2t—14 to 24 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard, firm; thin clay films on ped surfaces; calcareous, moderately alkaline; clear, smooth boundary.

B3—24 to 36 inches, light-brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, subangular blocky structure; hard, firm; calcareous, moderately alkaline; gradual, wavy boundary.

C1ca—36 to 54 inches, pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) when moist; hard, firm; many small concretions of calcium carbonate; calcareous, moderately alkaline; clear, wavy boundary.

C2—54 to 72 inches +, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; hard, firm; many films and threads of calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges from 8 to 18 inches in thickness and from brown to dark brown in color. The B horizon ranges from 16 to 30 inches in thickness and from clay loam to silty clay loam in texture. Its color is light brown to dark brown. Depth to the C1ca horizon is 24 to 48 inches.

LaCasa silty clay loam, 1 to 3 percent slopes (LcB).—This gently sloping soil is on uplands. Slopes are slightly concave. Areas of this soil average about 125 acres in size, but some are as large as 250 acres.

This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Ector gravelly loam, Wichita loam, and Lutie clay loam. Inclusions make up less than 8 percent of any given area.

This soil is used mainly for crops. (Capability unit IIe–2; Deep Hardland range site)

LaCasa silty clay loam, 3 to 5 percent slopes (LcC).—This gently sloping soil is on uplands. Slopes are concave. Areas of this soil are irregularly shaped and average about 20 acres in size, but some are as large as 60 acres.

The brown silty clay loam surface layer is about 10 inches thick. The next layer is brown clay loam about 18 inches thick. The underlying material is pink clay loam and is high in lime content.

Included with this soil in mapping are small areas of Ector gravelly loam, Wichita loam, and Lutie clay loam. Included soils make up less than 10 percent of any given area.

This soil is suited to cultivated crops but also is well suited to range. (Capability unit IIIe–2; Deep Hardland range site)

Lincoln Series

The Lincoln series consists of deep, very friable, calcareous, dominantly sandy soils that have bedding planes. These soils are on flood plains and are subject to frequent flooding. Slopes are less than 2 percent.

In a representative profile, the surface layer is pale-brown, calcareous loamy fine sand about 16 inches thick. The underlying material, to a depth of 50 inches, is light yellowish-brown fine sand that has bedding planes.

Available water capacity is low. Permeability is rapid. The hazard of soil blowing is severe.

Representative profile of a Lincoln loamy fine sand in an area of Lincoln soils in a pasture, 3,696 feet north of county road, from a point 1.0 mile west and 4.0 miles north of its intersection with State Highway 203, which is about 6.2 miles northwest of the intersection of State Highway 203 with Farm Road 1547 in Quail:

A1—0 to 16 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; single grain (structureless); soft, very friable; few thin (1/2 inch thick) strata of silt loam; calcareous, moderately alkaline; clear, smooth boundary.

C—16 to 50 inches +, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) when moist; single grain (structureless); loose when dry or moist; strata of silt loam and fine sandy loam; bedding planes evident; calcareous, moderately alkaline.

The A horizon ranges from 10 to 20 inches in thickness and from fine sand to fine sandy loam in texture. Its color ranges from pale brown to brown. The C horizon is loamy fine sand to fine sand and is very pale brown to light yellowish brown. Depth to the water table is 4 to 20 feet in most places.

Lincoln soils (Ls).—These nearly level to gently sloping soils are on flood plains. In places they have a slightly undulating surface and slopes ranging up to about 2.0 percent. The lower areas are flooded during heavy rains. A few, small, oval-shaped sand dunes that average about 3 feet high and about 150 feet long are in areas adjacent to rivers and creeks. In places the soils are dissected by channel scars or partly filled old stream channels. Areas of these soils are oblong and have smooth boundaries; they average about 20 acres in size, but some areas are as large as 100 acres. The texture of the surface layer ranges from fine sand to fine sandy loam.

Included with these soils in mapping are small areas of Enterprise very fine sandy loam and Yahola fine sandy loam that make up less than 5 percent of any given area.

Almost all the acreage of these soils is used for range. Cultivation is not feasible, because flooding is frequent. Wooded areas along the streams are good wildlife habitat.

These soils are subject to washing and to deposition of new soil material. Depth to the water table is 4 to 20 feet in most places. (Capability unit Vw–2; Sandy Bottomland range site)

Lutie Series

The Lutie series consists of deep, well-drained, calcareous, loamy soils that formed in shaly clay mainly of Permian age. These soils are gently sloping to sloping and are on uplands.

In a representative profile, the surface layer is a reddish-brown clay loam and silty clay loam about 12 inches thick. The next layer is silty clay loam to a depth of 60 inches. It is yellowish red and firm in the upper 7 inches, reddish brown in the next 5 inches, and red in the lower 36 inches.

Soil blowing is a slight hazard and water erosion is a moderate hazard in the more sloping areas. Runoff is medium, and permeability is moderate. Available water capacity is high.

Representative profile of Lutie clay loam, 1 to 3 percent slopes, 50 feet north of county road, from a point 800 feet east of its intersection with Farm Road 1439, which is about 9.0 miles east of the intersection of Farm Road and U.S. Highway No. 83 in Lutie:

A11—0 to 6 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; weak, granular structure; hard, friable; calcareous, moderately alkaline; clear, smooth boundary.

A12—6 to 12 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard, firm; calcareous, moderately alkaline; clear, smooth boundary.

B2—12 to 19 inches, yellowish-red (5YR 4/6) silty clay loam, yellowish red (5YR 3/6) when moist; moderate, medium, granular structure and moderate, fine, subangular blocky structure; hard, firm; common worm casts; few films and threads of calcium carbonate; calcareous, moderately alkaline; clear, smooth boundary.

B31ca—19 to 24 inches, reddish-brown (2.5YR 5/4) silty clay loam and a few lenses of shaly clay, reddish brown (2.5YR 4/4) when moist; weak, blocky structure; hard, firm; many films, threads, and strongly cemented concretions of calcium carbonate, mostly less than 2 centimeters in diameter; calcareous, moderately alkaline; gradual, wavy boundary.

B32ca—24 to 60 inches +, red (2.5YR 5/6) silty clay loam and lenses of shaly clay, red (2.5YR 4/6) when moist; weak, blocky structure; hard, friable; few films and threads of calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges from 10 to 16 inches in thickness and from loam to silty clay loam in texture. Its color is reddish brown to brown. The B2 horizon ranges from clay loam to silty clay loam and from reddish brown to yellowish red or red. Visible calcium carbonate in the B3ca horizon is 1 to about 5 percent, by volume. The content of clay in all horizons ranges from 18 to 35 percent, and less than 15 percent of the material is coarser than very fine sand.

Lutie clay loam, 1 to 3 percent slopes (LuB).—This gently sloping soil is on uplands. Areas are oval shaped; they average about 25 acres in size, but some are as large as 200 acres.

This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Wichita loam, LaCasa silty clay loam, Ector gravelly loam, Quinlan loam, and Woodward loam. Included soils make up less than 8 percent of any given area.

About 50 percent of the acreage of this soil is cultivated, and 50 percent is used for pasture or range. (Capability unit IIIe–7; Shallow Redland range site)

Lutie clay loam, 3 to 6 percent slopes (LuC).—This gently sloping to sloping soil is on uplands. Areas are irregularly shaped; they average about 20 acres in size, but some areas are as large as 200 acres.

The limy, reddish-brown clay loam surface layer is about 8 inches thick. The next layer is silty clay loam. It is yellowish red in the upper 10 inches, reddish brown in the next 6 inches, and red below.

Included with this soil in mapping are small areas of Cottonwood loam, Wichita loam, LaCasa silty clay loam, Ector gravelly loam, Quinlan loam, and Woodward loam. Included soils make up less than 10 percent of any given area.

About 30 percent of the acreage of this soil is cultivated, and 70 percent is used for pasture and range. (Capability unit IVe–2; Shallow Redland range site)

Lutie-Quinlan-Cottonwood complex (Lx).—This complex consists of sloping to moderately steep soils on uplands. Areas are rolling and are dissected by natural drains. They range from 30 to 3,000 acres in size, but they average about 600 acres.

About 50 percent of the complex is Lutie soils. They are on the smoother, less sloping areas of the complex. Quinlan soils make up about 20 percent of the complex. They are adjacent to and are more sloping than the Lutie soils and are in areas next to the natural drains. The Cottonwood soils make up about 20 percent of the complex. They are adjacent to the Quinlan soils and are the most steeply sloping soils in the complex. The remaining 10 percent of the complex consists of gypsum outcrops and small areas of LaCasa silty clay loam, Ector gravelly loam, Woodward loam, and Colorado loam.

The Lutie soils have a limy reddish-brown clay loam surface layer about 8 inches thick. The next layer is silty clay loam. It is yellowish red in the upper 10 inches, reddish brown and very limy in the next 5 inches, and red below.

The Quinlan soils have a reddish-brown loam surface layer about 5 inches thick. The next layer is a red, limy very fine sandy loam about 9 inches thick. The underlying material is limy, weathered red sandstone or packsand.

The Cottonwood soils have the profile described as representative for their series.

The soils in this complex are used for range; they are not suitable for cultivation. (Capability unit VIe–4; Lutie soils, Shallow Redland range site; Quinlan soils, Mixedland range site; Cottonwood soils, Gypland range site)

Mansker Series

The Mansker series consists of well-drained brown, calcareous, moderately permeable soils that are gently sloping to moderately steep.

In a representative profile, the surface layer is brown fine sandy loam about 12 inches thick. The next layer is light-brown friable loam about 6 inches thick. The underlying material in the upper 12 inches is pink loam that is about 15 percent visible calcium carbonate. Below this, to a depth of 60 inches, the underlying material is calcareous, reddish-yellow sandy loam.

The hazard of soil blowing is moderate, and that of water erosion is slight to moderate. Runoff is medium. Available water capacity is high.

Representative profile of Mansker fine sandy loam, 3 to 5 percent slopes, in a cultivated field, 1.1 miles east and 500 feet north of a point 3.0 miles south of the intersection of State Highway 203 and Farm Road 1547 in Quail:

Ap—0 to 6 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, granular structure; soft, friable; few fine concretions of calcium carbonate; calcareous, moderately alkaline; abrupt, smooth boundary.

A12—6 to 12 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/2) when moist; moderate, medium, subangular blocky structure; soft, very friable; calcareous, moderately alkaline; gradual, wavy boundary.

Bca—12 to 18 inches, light-brown (7.5YR 6/4) loam, dark brown (7.5YR 4/4) when moist; moderate, fine, granular structure; slightly hard, friable; visible calcium carbonate is about 6 percent by volume in the form of strongly and weakly cemented concretions, films and threads; calcareous, moderately alkaline; gradual, wavy boundary.

C1ca—18 to 30 inches, pink (7.5YR 8/4) loam, pink (7.5YR 7/4) when moist; weak, granular structure; hard, friable; few fine pores; common worm casts; soft masses and weakly cemented concretions of calcium carbonate make up about 15 percent of horizon, by volume; calcareous, moderately alkaline; diffuse, wavy boundary.

C2—30 to 60 inches +, reddish-yellow (5YR 7/6) sandy loam, yellowish red (5YR 5/6) when moist; hard, friable; many medium and fine concretions of calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges from 7 to 16 inches in thickness. Its color ranges from brown to dark brown. The Bca horizon is loam to clay loam and 3 to 8 inches thick. Its color is light brown to dark brown. Depth to the C1ca horizon ranges from 10 to 24 inches. Visible calcium carbonate in the C1ca horizon ranges from 15 to 40 percent, by volume.

Mansker fine sandy loam, 1 to 3 percent slopes (MaB).—This gently sloping soil is on uplands. Slopes are smooth and slightly convex. Areas are from 5 to 50 acres in size, but they average about 15 acres.

The brown fine sandy loam surface layer is about 14 inches thick and contains free lime. The next layer is light-brown loam, about 8 inches thick, and is very limy. The upper 14 inches of the underlying material is pink loam containing about 15 percent visible calcium carbonate. Below this, it is limy, reddish-yellow sandy loam.

Included with this soil in mapping are small areas of Woodward loam, Quinlan loam, Springer fine sandy loam, Miles fine sandy loam, and Enterprise very fine sandy loam. Inclusions make up less than 6 percent of any given area.

This soil is used mainly for crops. (Capability unit IIIe–8; Sandy Loam range site)

Mansker fine sandy loam, 3 to 5 percent slopes (MaC).—This gently sloping soil is in areas leading to natural drains. Slopes are convex. The areas are irregularly shaped; they are from 5 to 50 acres in size, but they average about 15 acres.

This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Woodward loam, Quinlan loam, Miles fine sandy loam, and Enterprise very fine sandy loam. Included soils make up less than 8 percent of any given area.

Most of this soil is cultivated. (Capability unit IVe–5; Sandy Loam range site)

Mansker fine sandy loam, 5 to 8 percent slopes (MaD).—This sloping soil is on ridgetops and in areas leading to natural drains. Slopes are convex. The surface layer is eroded and in some places has been removed. There are a few gullies in some places. Areas are irregularly shaped; they are from 5 to 50 acres in size, but they average about 15 acres.

The brown fine sandy loam surface layer is about 8 inches thick and contains free lime. The next layer is light-brown loam about 4 inches thick and is very limy. The upper 10 inches of the underlying material is pink loam containing about 20 percent visible calcium carbonate. Below this, it is limy, reddish-yellow sandy loam.

Included with this soil in mapping are small areas of Woodward loam, Quinlan loam, and Enterprise very fine sandy loam that make up less than 10 percent of any given area. This soil is not suited to cultivation and is used for range. (Capability unit VIe–3; Sandy Loam range site)

Mansker-Woodward complex (Md).—This complex consists of sloping to moderately steep soils on uplands. Slopes range from 5 to 16 percent but average about 8 percent. Areas have rolling topography and are dissected by natural drains (fig. 9). They average about 500 acres in size, but some are as large as 1,200 acres.

About 40 percent of the complex is Mansker soils. They are next to the natural drains and are the most steeply sloping soils of the complex. The Woodward soils make up about 35 percent of the complex. They are in the smoother areas of the complex and are less sloping than the Mansker soils. The remaining 25 percent of the complex consists of Quinlan loam, Miles fine sandy loam, Springer fine sandy loam, and Yahola fine sandy loam.

The Mansker soils have a brown fine sandy loam surface layer that is about 8 inches thick and contains free

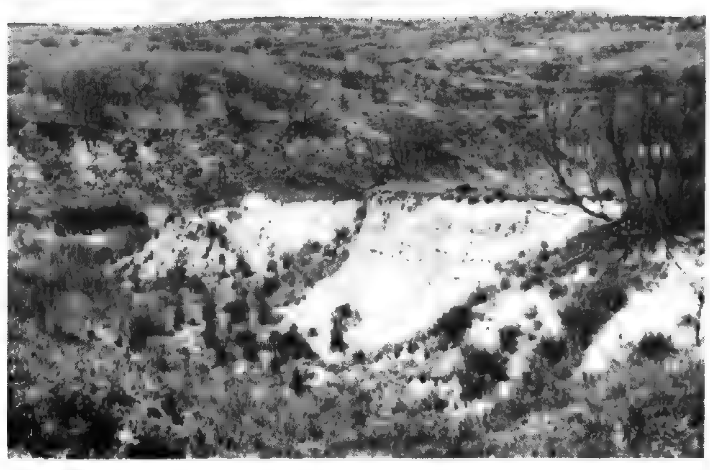


Figure 9.—Rolling, dissected topography of Mansker-Woodward complex.

lime. The next layer is light-brown loam about 4 inches thick and is very limy. The upper 10 inches of underlying material is pink loam containing about 20 percent visible calcium carbonate. Below this is reddish-yellow sandy loam.

The Woodward soils have a reddish-brown loam surface layer that is about 6 inches thick and contains free lime. The next layer is very friable, reddish-yellow very fine sandy loam and is about 14 inches thick. The underlying material is weakly cemented sandstone that begins at a depth of about 20 inches.

The soils in this complex are used for range. The hazard of erosion and the steepness of slopes make them unsuitable for cultivation. (Capability unit VIe–4; Mansker soils, Sandy Loam range site; Woodward soils, Mixedland range site)

Miles Series

The Miles series consists of well-drained, deep, moderately permeable, neutral, loamy and sandy soils. These soils are nearly level to gently sloping and are on uplands.

In a representative profile, the surface layer is dark-brown fine sandy loam about 10 inches thick. The next layer is friable, reddish-brown sandy clay loam in the upper 9 inches and firm, yellowish-red sandy clay loam in the lower 29 inches. The underlying material, to a depth of 65 inches, is yellowish-red fine sandy loam.

The hazard of soil blowing is moderate to severe, and the hazard of water erosion is moderate. Available water capacity is high.

Representative profile of Miles fine sandy loam, 1 to 3 percent slopes, in a cultivated field, 240 feet east of U.S. Highway No. 83, from a point 4.02 miles south of its intersection with Farm Road 338 in Wellington:

Ap—0 to 10 inches, dark-brown (7.5YR 4/4) fine sandy loam, dark brown (7.5YR 3/4) when moist; weak, granular structure; hard, friable; neutral; abrupt, smooth boundary.

B21t—10 to 19 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; moderate, very coarse, prismatic structure parting to weak, medium, subangular blocky structure; very hard, friable; few fine pores; thin, continuous clay films on ped surfaces; neutral; diffuse, smooth boundary.

B22t—19 to 48 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 3/6) when moist; moderate, very coarse, prismatic structure parting to moderate, medium, subangular blocky structure; very hard, firm; thin, continuous clay films on ped surfaces; neutral; gradual, smooth boundary.

C—48 to 65 inches +, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; hard, friable; contains siliceous pebbles 2 to 20 millimeters in diameter, visibly comprising less than 1 percent of horizon, by volume; neutral.

The A horizon ranges from 6 to 20 inches in thickness and from fine sandy loam to loamy fine sand in texture. Its color is brown to reddish brown. The B2t horizon ranges from 30 to 40 inches in thickness and from fine sandy loam to sandy clay loam in texture. Its color is reddish brown to red. Reaction of the C horizon ranges from neutral to moderately alkaline.

Miles and Altus soils, 0 to 1 percent slopes (MeA).—The soils in this undifferentiated group are nearly level. Areas are from 10 to 500 acres in size, but they average about 80 acres.

About 30 percent of the areas mapped as this group contains both Miles soils and Altus soils, the remaining 70 percent contains either the Miles soils or the Altus soils. Approximately 70 percent of the total acreage of the mapping unit is Miles fine sandy loam, and about 25 percent is Altus fine sandy loam. Small areas of Abilene clay loam, Wichita loam, Carey loam, and Miles loamy fine sand make up the remaining 5 percent. Miles soils and Altus soils are in similar positions on the landscape.

The Miles soils in this mapping unit have a brown, neutral fine sandy loam surface layer about 14 inches thick. The next layer is about 48 inches thick and is sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is yellowish-red fine sandy loam and begins at a depth of about 62 inches.

The Altus soils in this mapping unit are similar to that described as representative of the series.

About 75 percent of this mapping unit is used for crops, and 25 percent is used for pasture or range. (Capability unit IIIe–4; Sandy Loam range site)

Miles fine sandy loam, 1 to 3 percent slopes (MfB).—This gently sloping soil is on uplands. Areas average about 400 acres in size, but some are as large as 1,500 acres.

This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Altus fine sandy loam, Springer fine sandy loam, Wichita loam, and Miles loamy fine sand. Included soils make up less than 6 percent of any given area.

About 75 percent of the acreage of this soil is used for crops, and 25 percent is used for pasture or range. (Capability unit IIIe–4; Sandy Loam range site)

Miles fine sandy loam, 3 to 5 percent slopes (MfC).—This gently sloping soil is on uplands. Areas are irregularly shaped; they average about 40 acres in size, but some areas are as large as 200 acres.

The neutral, brown fine sandy loam surface layer is about 8 inches thick. The next layer is about 32 inches thick and is sandy clay loam that is reddish brown in the upper part and yellowish-red in the lower part. The underlying material is yellowish-red fine sandy loam.

Included with this soil in mapping are small areas of Springer fine sandy loam and Miles loamy fine sand that make up less than 10 percent of any given area.

This soil is used mostly for crops, but it is also well suited to pasture or range. (Capability unit IVe–4; Sandy Loam range site)

Miles fine sandy loam, 3 to 5 percent slopes, eroded (MfC2).—This gently sloping upland soil is in areas leading to natural drains. Areas are irregularly shaped; they average about 15 acres in size, but some areas are as large as 80 acres.

This soil has an eroded surface layer, and the lower layers are exposed in a few places. There are a few, broad, shallow gullies, but they are easily crossed by farm implements. The neutral, brown fine sandy loam surface layer is about 6 inches thick. The next layer, about 30 inches thick, is loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is yellowish red sandy loam.

Included with this soil in mapping are small areas of Springer fine sandy loam and Miles loamy fine sand that make up less than 10 percent of any given area.

This soil is used for crops. It is also well suited to range. (Capability unit IVe–3; Sandy Loam range site)

Miles loamy fine sand, 0 to 3 percent slopes (MlB).—This nearly level to gently sloping soil occupies areas that range from 20 to 2,000 acres in size but average about 400 acres.

The brown, neutral loamy fine sand surface layer is about 14 inches thick. The next layer is about 50 inches thick. It is a firm sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is calcareous, pink sandy clay loam in the upper 20 inches. Below this, to a depth of 90 inches, the underlying material is a reddish-yellow sandy clay loam.

Included with this soil in mapping are small areas of Brownfield fine sand, Nobscot fine sand, Springer loamy fine sand, and Miles fine sandy loam. Inclusions make up less than 10 percent of any one area.

About 50 percent of the acreage of this soil is cultivated, and 50 percent is used for range. (Capability unit IVe–6; Sandyland range site)

Miles loamy fine sand, 3 to 5 percent slopes (MlC).—This gently sloping soil is on uplands. Areas are from 10 to 200 acres in size, but they average about 40 acres.

The neutral, brown loamy fine sand surface layer is about 10 inches thick. The next layer, about 40 inches thick, is firm sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is pink, calcareous sandy clay loam in the upper 15 inches grading to reddish-yellow sandy clay loam.

Included with this soil in mapping are small areas of Brownfield fine sand, Nobscot fine sand, and Springer loamy fine sand that make up less than 12 percent of any given area.

This soil is unsuitable for cultivation but is well suited to range. (Capability unit VIe–6; Sandyland range site)

Miles soils, severely eroded (Ms3).—These gently sloping, severely eroded soils are on uplands. Slopes average about 2.5 percent. The areas are irregularly shaped; they average about 20 acres in size, but some areas are as large as 400 acres.

These soils have a surface layer that ranges in texture from loamy fine sand to sandy clay loam, depending on the degree of erosion. On about 20 percent of the acreage, the original surface layer has been removed and the reddish-brown sandy clay loam subsoil is exposed. Elsewhere, the surface layer is neutral, brown loamy fine sand about 6 inches thick, and this abruptly overlies the next layer of sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is pink sandy clay loam that is very limy and begins at a depth of about 36 inches.

Included with this soil in mapping are small areas of Springer loamy fine sand, Brownfield fine sand, and Nobscot fine sand. Included soils make up less than 12 percent of any given area.

Severe erosion makes these soils unsuitable for cultivation. They are used for range, but grazing is limited. There are many deep gullies that cannot be crossed with farm implements. In some areas fence lines have accumulations of fine sand 5 to 20 feet deep. (Capability unit VIe–6; Sandyland range site)

Nobscot Series

The Nobscot series consists of deep, well-drained, moderately rapidly permeable, sandy soils. These soils are gently sloping to sloping and are on uplands.

In a representative profile, the surface layer is brown fine sand about 4 inches thick. Below this layer is about 27 inches of loose, light-brown fine sand. The next layer is very friable, reddish-yellow fine sandy loam about 15 inches thick (fig. 10). The underlying material, to a depth of 72 inches, consists of loose, reddish-yellow loamy sand.

Nobscot soils are subject to a severe hazard of soil blowing and a slight hazard of water erosion. Runoff is very slow. Available water capacity is low.

In Collingsworth County the Nobscot soils were mapped only in a complex with the Brownfield soils. This complex is described under the Brownfield series.

Figure 10.—Profile of a Nobscot fine sand.

Representative profile of a Nobscot fine sand, in an area of Brownfield-Nobscot fine sands in native range, 800 feet south of a county road, from a point 2.35 miles west of its intersection with Farm Road 1981, from a point 5.0 miles west of its intersection with U.S. Highway No. 83, which is about 5.0 miles south of the intersection of U.S. Highway No. 83 and Farm Road 1439 in Lutie:

A1—0 to 4 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; single grain (structureless); loose when dry and moist; slightly acid; clear, smooth boundary.

A2—4 to 31 inches, light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; single grain (structureless); loose when dry and moist; medium acid; gradual, smooth boundary.

B2t—31 to 46 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) when moist; weak, prismatic structure; hard, very friable; thin, discontinuous clay films on faces of prisms; few medium and fine pores; common lens of light sandy clay loam 1/2 to 2 inches thick; medium acid; gradual, smooth boundary.

C—46 to 72 inches +, reddish-yellow (5YR 6/6) loamy sand, yellowish red (5YR 5/6) when moist; single grain (structureless); loose when dry and moist; neutral.

The A1 horizon ranges from 4 to 8 inches in thickness and is yellowish brown to brown. The A2 horizon is 12 to 32 inches thick and is brown to light yellowish brown. The B2t horizon ranges from 12 to 30 inches in thickness and is light reddish brown to yellowish brown or red. Depth to the C horizon is 30 to 50 inches.

Quinlan Series

The Quinlan series consists of shallow, well-drained, very friable, calcareous, loamy soils that formed over sandstone or packsand. These soils are gently sloping to strongly sloping and are on uplands.

In a representative profile, the surface layer is reddish-brown loam about 5 inches thick. The next layer is red very fine sandy loam about 9 inches thick. The underlying material, to a depth of 30 inches, consists of calcareous, weathered, red sandstone or packsand.

Runoff is medium to rapid. Permeability is moderately rapid. Available water capacity is moderate.

Representative profile of a Quinlan loam in an area of Quinlan-Woodward loams in native range, 2,480 feet east of Farm Road 1547, at a point 4.75 miles south of the intersection of that road and State Highway 203 in Quail:

A1—0 to 5 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; weak, granular structure; slightly hard, very friable; calcareous, moderately alkaline; gradual, wavy boundary.

B—5 to 14 inches, red (2.5YR 4/6) very fine sandy loam, dark red (2.5YR 3/6) when moist; weak, granular structure; slightly hard, very friable; calcareous, moderately alkaline; gradual, wavy boundary.

R—14 to 30 inches +, red (2.5YR 5/8), weathered sandstone or packsand, red (2.5YR 4/8) moist; calcareous, moderately alkaline.

The A horizon ranges from 4 to 8 inches in thickness and from reddish brown to yellowish red in color. The B horizon ranges from 6 to 12 inches in thickness and is red to yellowish red. Depth to the R layer is 10 to 20 inches.

Quinlan-Woodward loams (Qw).—This complex consists of sloping to strongly sloping soils on rolling dissected uplands and tops of small mesas. Slopes range from 5 to 12 percent but average about 10 percent. Areas average about 400 acres in size, though some areas are as large as 2,000 acres.

Quinlan soils make up about 40 percent of the complex. They are on the ridgetops and in areas leading to the natural drains. The Woodward soils make up about 35 percent of the complex. They are on the smoother areas of the complex and are less sloping than the Quinlan soils. The remaining 25 percent of the complex is made up of outcrops of sandstone, limestone, and packsand and small areas of LaCasa silty clay loam, Ector gravelly loam, Wichita loam, and Lutie clay loam.

The Quinlan soil in this complex has the profile described as representative for the series (fig. 11).

The Woodward soil has a reddish-brown loam surface layer that is about 6 inches thick and contains free lime. The next layer is very friable, reddish-yellow very fine sandy loam about 14 inches thick. The underlying material is weakly cemented sandstone and begins at a depth of about 20 inches.

The soils in this complex are unsuitable for cultivation but are well suited to range. (Capability unit VIe-4; Mixedland range site)

Rough Broken Land

This miscellaneous land type consists of escarpment remnants, steep canyon walls, severely eroded areas, and rough, dissected breaks along narrow, V-shaped valleys. The soil material is loamy and ranges in texture from very fine sandy loam to silt loam. Many gypsum outcrops are on the steeper slopes.

Rough broken land-Woodward complex (Rw).—This complex occurs in large areas (fig. 12). Slopes dominantly range from 20 to 80 percent, and vertical relief ranges from 25 to 200 feet.

Rough broken land makes up about 60 percent of the complex, and Woodward loam makes up 25 percent of it. Woodward loam is in the smoother areas of the complex. It has a surface layer of reddish-brown loam that is about 6 inches thick and contains free lime. The subsurface layer is very friable, reddish-yellow very fine sandy loam about 14 inches thick. The underlying material of weakly cemented sandstone begins at a depth of about 20 inches.

The remaining 15 percent of the complex is mainly Quinlan loam, Cottonwood loam, Lutie clay loam, Colorado loam, Spur clay loam, and Yahola fine sandy loam. These soils occupy pockets, knobs, mesas, foot slopes, and narrow bottoms of alluvial drains.

This mapping unit is not suitable for cultivation. Some areas are so steep and rough that they are not readily accessible to livestock. (Capability unit VIIs-2; Rough broken land, Rough Breaks range site; Woodward soils, Mixedland range site)

Springer Series

The Springer series consists of deep, well-drained, neutral, loamy and sandy soils. These soils are gently sloping to sloping and are on uplands.

In a representative profile, the surface layer is brown and reddish-brown loamy fine sand that is about 18 inches thick. The next layer is yellowish-red fine sandy loam in the upper 12 inches and yellowish-red loamy fine sand in

Figure 11.—**Outcrop of partially weathered Permian sandstone over packsand. Such outcrops occur in areas of Quinlan-Woodward loams.**

the lower 25 inches. The underlying material, to a depth of 60 inches, is reddish-yellow loamy fine sand.

On the Springer soils there is a moderate to severe hazard of soil blowing and a slight to moderate hazard of water erosion. Permeability is moderately rapid.

Representative profile of Springer loamy fine sand, undulating, 150 feet west of U.S. Highway No. 83, from a point 4.2 miles north of its intersection with Farm Road 338 in Wellington:

A11—0 to 10 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) when moist; single grain (structureless) ; loose when dry and moist; neutral; clear, smooth boundary.

A12—10 to 18 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; weak prismatic structure; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

B2t—18 to 30 inches, yellowish-red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/6) when moist; weak, coarse, prismatic structure; hard, very friable; thin, discontinuous clay films on vertical faces of prisms; slightly acid; gradual, smooth boundary.

B3—30 to 55 inches, yellowish-red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/8) when moist; single grain (structureless) ; loose when dry and moist; slightly acid; gradual, smooth boundary.

C—55 to 60 inches +, reddish-yellow (5YR 6/8) loamy fine sand, yellowish red (5YR 4/8) when moist; single grain (structureless) ; loose when dry and moist; neutral.

The A horizon ranges from 6 to 20 inches in thickness and from light yellowish brown to reddish brown in color. Its texture ranges from fine sandy loam to loamy fine sand. The B horizon is 16 to 38 inches thick and is reddish yellow to red. Content of gravel in the C horizon is less than 1 to about 5 percent, by volume.

Springer fine sandy loam, 3 to 5 percent slopes (SfC).—This gently sloping soil is on uplands. Its areas are from 5 to 250 acres in size, but they average about 60 acres.

The reddish-brown, neutral fine sandy loam surface layer is about 8 inches thick. The next layer is very friable, yellowish-red fine sandy loam about 24 inches thick. The underlying material, to a depth of about 60 inches, is yellowish-red loamy fine sand.

Included with this soil in mapping are small areas of Enterprise very fine sandy loam, Springer loamy fine sand, Miles fine sandy loam, and Miles loamy fine sand. Inclusions make up less than 8 percent of any given area.

This soil is cultivated, but it is also well suited for range. In a few places the more sloping areas are eroded and have rills and shallow gullies. These are easily crossed with farm implements. (Capability unit IVe-9; Sandy Loam range site)

Figure 12.—In the background is a typical area of Rough broken land-Woodward complex.

Springer fine sandy loam, 5 to 8 percent slopes (SfD).—This sloping soil is on uplands. Areas are from 10 to 300 acres in size, but they average about 150 acres.

The neutral, reddish-brown fine sandy loam surface layer is about 6 inches thick. The next layer is very friable, yellowish-red fine sandy loam about 18 inches thick. The underlying material is yellowish-red loamy fine sand that begins at a depth of about 22 inches.

Included with this soil in mapping are small areas of Enterprise very fine sandy loam, Springer loamy fine sand, and Miles fine sandy loam. Inclusions make up less than 10 percent of any given area.

This soil is used for range. (Capability unit VIe–5; Sandy Loam range site)

Springer loamy fine sand, undulating (SgB).—This gently undulating soil is on uplands. Slopes average about 2 percent. Areas average about 400 acres in size, but some are as large as 2,000 acres.

This soil has the profile described as representative of the Springer series.

Included with this soil in mapping are small areas of Brownfield fine sand, Nobscot fine sand, and Miles loamy fine sand. Included soils make up less than 10 percent of any given area.

This soil is used mainly for range, but some areas are cultivated. In some areas fence lines have accumulations of fine sand that range from 1 to about 10 feet deep. (Capability unit IVe–11; Sandyland range site)

Springer loamy fine sand, hummocky (SgD).—This gently sloping soil is on uplands. Slopes average about 4 percent. Soil areas average about 250 acres in size, but some are as large as 2,000 acres.

This soil has a brown and reddish-brown loamy fine sand surface layer about 12 inches thick. The next layer is about 22 inches thick. It is yellowish-red fine sandy loam in the upper part and loamy fine sand in the lower part. The underlying material is reddish-yellow loamy fine sand.

Included with this soil in mapping are small areas of Brownfield fine sand, Nobscot fine sand, Miles loamy fine sand, and Tivoli fine sand. Inclusions make up less than 12 percent of any one area.

Slopes and the erosion hazard make this soil unsuitable for cultivation. It is used for range. In some areas, fence lines have accumulations of fine sand that are 10 to about 30 feet wide and up to 20 feet deep. (Capability unit VIe–6; Sandyland range site)

Springer-Brownfield-Blown-out land complex (Sn).—This complex consists of windblown, gently sloping soils on uplands. Slopes average about 4 percent. The areas average about 40 acres in size, but some range up to 200 acres.

Springer soils make up about 40 percent of the complex. They are in the less sloping areas of the complex. The Brownfield soils make up about 25 percent of the complex and are in the more sloping parts of the mapping unit. About 25 percent is Blown-out land, which occupies the severely eroded areas of the complex. The remaining 10 percent of this complex consists of small areas of Nobscot fine sand, Tivoli fine sand, and Miles loamy fine sand.

The Springer soils in this complex have a brown and reddish-brown loamy fine sand eroded surface layer about 12 inches thick. The next layer is about 22 inches thick. It is yellowish-red fine sandy loam in the upper part and loamy fine sand in the lower part. The underlying material is reddish-yellow loamy fine sand.

The Brownfield soils in this complex have an eroded surface layer of loose, slightly acid, brown fine sand about 20 inches thick. The next layer is red, friable sandy clay loam about 20 inches thick. The underlying material is at a depth of about 40 inches and consists of friable, red sandy loam.

Blown-out land component is severely eroded. Its surface layer ranges in texture from fine sand to sandy clay loam, depending on the degree of erosion.

The soils in this complex are not suitable for cultivation and are used for range. Wind has removed part or all of the original surface layer in most areas. Gullies 2 to 4 feet deep and 10 to 15 feet wide are common where slopes are 300 feet or longer. Fence lines and tree rows have accumulations of fine sand 10 to 40 feet wide and up to 20 feet deep. (Capability unit VIe–7; Springer soils, Sandyland range site; Brownfield soils, Deep Sand range site; Blown-out land, Sandyland range site)

Spur Series

The Spur series consists of deep, well-drained, friable, calcareous, moderately permeable, loamy soils. The soils are nearly level to gently sloping and lie on flood plains.

In a representative profile, the surface layer is dark-brown clay loam about 18 inches thick. The next layer is brown clay loam about 16 inches thick. The underlying material, to a depth of 60 inches, is reddish-brown clay loam.

These soils are subject to flooding. They have a high available water capacity.

Representative profile of Spur clay loam in a cultivated field 9,760 feet east of U.S. Highway No. 83 and 100 feet north of Elm Creek, from a point 7.7 miles north of intersection of that highway with Farm Road 1439 in Lutie:

Ap—0 to 5 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, subangular blocky structure; hard, friable; calcareous, moderately alkaline; abrupt, smooth boundary.

A1—5 to 18 inches, dark-brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/3) when moist; moderate, medium, subangular blocky structure; very hard, friable; many worm casts; calcareous, moderately alkaline; clear, smooth boundary.

B—18 to 34 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard, friable; common worm casts and insect cavities; few films and threads of calcium carbonate; calcareous, moderately alkaline; clear, smooth boundary.

C—34 to 60 inches +, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard, firm; few films and threads of calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges from 10 to 20 inches in thickness and from grayish brown to dark brown in color. The B horizon ranges from 10 to 30 inches in thickness and from clay loam to silty clay loam in texture. Its color ranges from reddish brown to dark brown. Depth to C horizon is 28 to 50 inches.

Spur clay loam (Sp).—This nearly level to gently sloping soil is on flood plains (fig. 13). Slopes average about 0.6 percent, but in places they range up to about 2.0 percent. Areas are oblong, have smooth boundaries, and average about 20 acres in size, but some areas are as large as 150 acres.

This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of Colorado loam, Yahola fine sandy loam, Quinlan loam, Cottonwood loam, and soils that are dark colored to a depth of more than 20 inches. Inclusions make up less than 5 percent of any given area.

Areas of this soil are flooded about once in every 5 to 10 years but remain flooded less than 24 hours. Damage to crops is minor.

Most of this soil is cultivated, but the soil is also well suited to pasture and range. (Capability unit IIce–1; Loamy Bottomland range site)

Spur and Colorado soils (Sr).—The soils in this undifferentiated group are nearly level to gently sloping. They are on flood plains along the major streams and their tributaries. In places the surface is gently undulating and slopes range to about 2 percent. The surface is irregular and in places is dissected by channel scars or partly filled old stream channels. After some floods, there are thin deposits of silty material and litter on the surface. The stream channels change frequently. Mapped areas are oblong, have smooth boundaries, and average about 50 acres in size.

About 30 percent of the areas mapped as this group contain both Spur and Colorado soils, and the other areas

Figure 13.—Nearly level flood plain occupied by Spur clay loam in foreground. In background is an area of Rough broken land-Woodward complex.

contain either Spur soils or Colorado soils. Approximately half of the total acreage of the mapping unit is Spur clay loam, and the other half is Colorado loam. Both of these soils occupy similar positions in the landscape.

The Spur soils have a surface layer of dark-brown clay loam that contains free lime and is about 20 inches thick. The next layer is brown, friable clay loam about 18 inches thick. The underlying material consists of reddish-brown firm clay loam that is high in content of lime.

The Colorado soils have a surface layer of friable, reddish-brown loam containing free lime. This layer is about 13 inches thick. The underlying material is friable loam that has evident bedding planes.

These soils are unsuitable for cultivation and are used for range. They are frequently flooded and are subject to washing and to deposition of silty material and litter. (Capability unit Vw-1; Loamy Bottomland range site)

Tivoli Series

The Tivoli series consists of deep, neutral, sandy soils. In these soils the only evidences of horizon development are slight accumulations of organic matter and darker colors in the upper few inches. The soils are on dune-shaped topography.

In a representative profile, the surface layer is light-brown fine sand about 8 inches thick. The underlying material, to a depth of 60 inches, is reddish-yellow fine sand.

The hazard of soil blowing is severe, and that of water erosion is slight. The soils are excessively drained, and runoff is very slow. Permeability is rapid, and available water capacity is low.

Representative profile of Tivoli fine sand in native range, 100 feet west of Farm Road 1547, from a point 7.6 miles north of its intersection with State Highway 203 in Quail:

A1—0 to 8 inches, light-brown (7.5YR 6/4) fine sand, dark brown (7.5YR 4/4) when moist; single grain (structureless); loose when dry and moist; neutral; clear, smooth boundary.

C—8 to 60 inches +, reddish-yellow (7.5YR 8/6) fine sand, reddish yellow (7.5YR 7/6) when moist; single grain (structureless); loose when dry and moist; neutral.

The A horizon ranges from 4 to 10 inches in thickness. Its color is pale brown to dark brown when dry. The C horizon ranges from brown to yellow.

Tivoli fine sand (Tv).—This soil is in areas where dunes have formed. These dunes range from 10 to 40 feet in height and cover 5 to 20 acres. Some of the areas have a billowy appearance. Slopes range from 3 to 8 percent but average about 5 percent. Areas of this soil are oval shaped, have smooth boundaries, and average about 80 acres in size. Some areas are as large as 500 acres.

Included with this soil in mapping are small areas of Springer loamy fine sand, Brownfield fine sand, Nobscot fine sand, and Miles loamy fine sand. Inclusions make up less than 8 percent of any given area.

Slope and the erosion hazard make this soil unsuitable for cultivation. This soil is used for range. (Capability unit VIIe-1; Deep Sand range site)

Wichita Series

The Wichita series consists of deep, neutral, moderately slowly permeable, loamy soils. These soils are nearly level to gently sloping and are on uplands.

In a representative profile, the surface layer is reddish-brown loam about 10 inches thick. The next layer is firm clay loam to a depth of 60 inches. It is reddish-brown in the upper 27 inches, yellowish red and calcareous in the next 14 inches, and red in the lower 9 inches.

On Wichita soils there is a slight hazard of soil blowing and a slight to moderate hazard of water erosion. These soils are well drained, and runoff is slow to medium. Available water capacity is high.

Representative profile of Wichita loam, 1 to 3 percent slopes, in cultivated field 200 feet west of county road, from a point 4.8 miles north of its intersection with Farm Road 1439, which is about 3.0 miles east of the intersection of Farm Road 1439 and U.S. Highway No. 83 in Lutie:

Ap—0 to 10 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; weak, granular structure; slightly hard, friable; neutral; abrupt, smooth boundary.

B21t—10 to 16 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, blocky and subangular blocky structure; very hard, firm; thin clay films on ped surfaces; neutral; clear, smooth boundary.

B22t—16 to 37 inches, reddish-brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, subangular blocky structure; very hard, firm; thin patchy clay films on peds; calcareous, moderately alkaline; clear, wavy boundary.

B23tca—37 to 51 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; moderate, medium, subangular blocky structure; hard, firm; few clay films; visible calcium carbonate in the form of films, threads, and soft masses makes up about 10 percent of the horizon, by volume; calcareous, moderately alkaline; gradual, wavy boundary.

B24t—51 to 60 inches +, red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) when moist; moderate, medium, subangular blocky structure; hard, firm; few clay films; calcareous, moderately alkaline.

The A horizon ranges from 7 to 16 inches in thickness. Its color ranges from reddish brown to brown. The B horizon ranges from 50 to 60 inches in thickness and from clay loam to sandy clay loam in texture. Color ranges from reddish brown to yellowish red.

Wichita loam, 0 to 1 percent slopes (WcA).—This nearly level soil is on uplands. Areas average about 80 acres in size, but some are as large as 400 acres.

The neutral, reddish-brown loam surface layer is about 16 inches thick. The next layer is reddish-brown clay loam in the upper 30 inches. Below this, it is yellowish-red clay loam that contains about 10 percent visible calcium carbonate.

Included with this soil in mapping are small areas of LaCasa silty clay loam, Carey loam, Altus fine sandy loam, and Miles fine sandy loam. Included soils make up less than 6 percent of any given area.

About 80 percent of this soil is cultivated. The rest is used for pasture or range. (Capability unit IIce-4; Deep Hardland range site)

Wichita loam, 1 to 3 percent slopes (WcB).—This gently sloping soil is on uplands. Areas of this soil average about

100 acres in size, but some range to as much as 200 acres. In a few places there are shallow gullies that are easily crossed with farm implements.

This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of LaCasa silty clay loam, Carey loam, and Miles fine sandy loam. These make up less than 8 percent of any given area.

This soil is used mostly for crops. (Capability unit IIIe-2; Deep Hardland range site)

Wichita-Lutie loams, 0 to 2 percent slopes (WlA).—This complex consists of nearly level to gently undulating soils on uplands (fig. 14). Slopes range from smooth to concave or convex. Mapped areas average about 250 acres, but some are as large as 900 acres.

Wichita soils make up about 60 percent of the complex. They are in slightly concave depressions and on intervening flats between knolls. The Lutie soils make up about 35 percent of the complex. They are more sloping than the Wichita soils and are on oval-shaped convex knolls. The remaining 5 percent consists of Quinlan loam, Woodward loam, LaCasa silty clay loam, and Miles fine sandy loam.

The Wichita soil in this complex has a natural reddish-brown loam surface layer about 16 inches thick. The next layer is reddish-brown clay loam in the upper 30 inches. Below this, it is yellowish-red clay loam that contains about 10 percent visible calcium carbonate.

The Lutie soil has a limy, reddish-brown loam and silty clay loam surface layer about 12 inches thick. The next layer is silty clay loam. It is yellowish red in the upper 12 inches, reddish brown and limy in the next 8 inches, and red in the lower part.

These soils are mainly used for crops. Some small areas are used for pasture or range. (Capability unit IIIe-2; Wichita soils, Deep Hardland range site; Lutie soils, Shallow Redland range site)

Wichita-Lutie loams, 2 to 6 percent slopes (WlC).—This complex consists of soils on uplands. Slopes are gently undulating to gently rolling. Areas average about 40 acres in size, but some are as large as 300 acres.

Wichita soils make up about 50 percent of the complex. They are in hollows and in areas between knolls. The Lutie soils make up about 45 percent of the complex. They are more sloping than the Wichita soils and are on knolls and gently sloping oval-shaped hills. The remaining 5 percent consists of small areas of Quinlan loam, Woodward loam, LaCasa silty clay loam, and Miles fine sandy loam.

The Wichita soil in this complex has a neutral, reddish-brown loam surface layer about 10 inches thick. The next layer is firm clay loam. It is reddish brown to a

Figure 14.—Gently undulating topography of Wichita-Lutie loams, 0 to 2 percent slopes. Wichita loam is in slightly concave depressions and on intervening flats. Lutie clay loam is on the oval, convex knolls.

depth of about 37 inches. Below this, it is yellowish red and contains about 10 percent visible calcium carbonate.

The Lutie soil has a limy, reddish-brown loam and silty clay loam surface layer about 8 inches thick. The next layer is silty clay loam. It is yellowish red in the upper 10 inches, reddish brown in the next 6 inches, and red in the lower part.

These soils are used mostly for crops. (Capability unit IVe-2; Wichita soils, Deep Hardland range site; Lutie soils, Shallow Redland range site)

Wichita-Lutie loams, 2 to 6 percent slopes, eroded (WlC2).—This complex consists of gently sloping to sloping, eroded soils on uplands. Mapped areas range from 10 to 100 acres, but average about 20 acres. There are rills and shallow gullies that are easily crossed with farm implements. In a few places the lower layers are exposed at the surface.

Wichita soils make up about 50 percent of the complex. They are in hollows and in areas between knolls and oval-shaped hills. The Lutie soils make up about 40 percent of the complex. They are more sloping than the Wichita soils and are on knolls and oval-shaped hills. The remaining 10 percent consists of small areas of Quinlan loam, Woodward loam, LaCasa silty clay loam, and Miles fine sandy loam.

The Wichita soil in this complex has a surface layer of reddish-brown loam about 7 inches thick. The next layer is firm clay loam. It is reddish brown to a depth of about 29 inches. Below this, it is yellowish red and contains about 15 percent visible calcium carbonate.

The Lutie soil in this complex has a surface layer that is limy, reddish brown, and about 8 inches thick. It is loam in the upper part and silty clay loam in the lower part. The next layer is silty clay loam. It is yellowish red in the upper 10 inches, reddish brown and limy in the next 5 inches, and red in the lower part.

This mapping unit is used for cropland and is well suited to pasture or range. (Capability unit IVe-3; Wichita soils, Deep Hardland range site; Lutie soils, Shallow Redland range site)

Woodward Series

The Woodward series consists of calcareous, loamy soils that are moderately deep over weakly cemented sandstone. The soils are gently sloping to steep and are on dissected uplands.

In a representative profile, the surface layer is reddish-brown loam about 8 inches thick. The next layer is reddish-yellow very fine sandy loam about 19 inches thick and is high in calcium carbonate in the lower part. The underlying material, to a depth of 60 inches, is light-red, weakly cemented sandstone.

Soil blowing is a slight hazard, and water erosion is a slight to severe hazard. The soils are well drained, and surface runoff is medium to rapid. Permeability is moderate. Available water capacity is high.

Representative profile of Woodward loam, 3 to 5 percent slopes, 528 feet east of county road, from a point 4.5 miles north of its intersection with State Highway 203, which is about 10 miles east of the intersection of State Highway 203 and U.S. Highway No. 83 in Wellington:

A1—0 to 8 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) when moist; weak, granular structure; soft, very friable; calcareous, moderately alkaline; gradual, smooth boundary.

B2—8 to 20 inches, reddish-yellow (5YR 6/6) very fine sandy loam, yellowish red (5YR 4/6) when moist; weak, granular structure; slightly hard, very friable; calcareous, moderately alkaline; gradual, wavy boundary.

B3ca—20 to 27 inches, reddish-yellow (5YR 7/6) very fine sandy loam, yellowish red (5YR 5/6) when moist; weak, granular structure; hard, friable; contains many fine concretions of calcium carbonate; calcareous, moderately alkaline; gradual, wavy boundary.

R—27 to 60 inches, light-red (2.5YR 6/8) weakly cemented sandstone of very fine sandy loam texture; calcareous, moderately alkaline.

The A horizon ranges from 6 to 12 inches in thickness and from reddish brown to yellowish red in color. The B2 horizon is 10 to 20 inches thick and is loam to very fine sandy loam. Its color ranges from reddish yellow to reddish brown. The B3ca horizon is 4 to 15 inches thick. Visible calcium carbonate in the B3ca horizon ranges from 1 to 15 percent, by volume. Depth to the R layer of weakly cemented sandstone ranges from 20 to 40 inches.

Woodward loam, 1 to 3 percent slopes (WoB).—This gently sloping soil is in areas leading to natural drains on uplands. Slopes are plane. Areas range from 10 to 400 acres in size but average about 100 acres.

The reddish-brown loam surface layer is about 12 inches thick and contains free lime. The next layer is reddish-yellow very fine sandy loam and is about 16 inches thick. The underlying material of weakly cemented sandstone begins at a depth of 38 inches.

Included with this soil in mapping are small areas of Springer fine sandy loam, Carey loam, Wichita loam, and Lutie clay loam. Included soils make up less than 6 percent of any given area.

This soil is mostly cultivated. (Capability unit IIe-1; Mixedland range site)

Woodward loam, 3 to 5 percent slopes (WoC).—This gently sloping soil is mostly along natural drains on rolling uplands. Areas are irregularly shaped and average about 40 acres in size, but some are as large as 300 acres.

This soil has the profile described as representative of the series. In a few places this soil is eroded and rills have formed.

Included with this soil in mapping are small areas of Enterprise very fine sandy loam, Springer fine sandy loam, and Miles fine sandy loam. Inclusions make up less than 10 percent of any given area.

About 50 percent of this soil is used for crops, and 50 percent is used for pasture or range. (Capability unit IIIe-3; Mixedland range site)

Woodward-Quinlan loams, 2 to 5 percent slopes (WuC).—This complex consists of gently sloping soils on uplands. Shallow gullies have formed in a few places where the soils are unprotected. Mapped areas are irregularly shaped and average about 15 acres in size, but some areas are as large as 100 acres.

Woodward loam makes up about 65 percent of the complex and is on the smoother parts of the complex. Quinlan loam makes up about 30 percent and is more sloping than the Woodward loam. The remaining 5 percent is made up of small areas of Carey loam, Wichita loam, and Lutie clay loam.

The Woodward soil has a reddish-brown loam surface layer that is about 8 inches thick and contains free lime. The next layer is reddish-yellow very fine sandy loam

about 19 inches thick. The underlying material is weakly cemented sandstone and begins at a depth of 27 inches.

The Quinlan soil has a reddish-brown loam surface layer about 8 inches thick. The next layer is limy, red very fine sandy loam about 10 inches thick. The underlying material consists of limy, weathered, red sandstone or packsand.

About 60 percent of this complex is cultivated, and 40 percent is used for pasture or range. (Capability unit IIIe–3; Mixedland range site)

Woodward-Yahola-Breaks complex (Wy).—This complex consists of nearly level soils along drainageways, moderately steep soils on breaks adjacent to the drains, and sloping soils above the breaks. Slopes average about 8 percent. Areas are long and narrow and average about 600 feet wide, but some areas are as wide as 2,000 feet. Areas average about 230 acres in size, though some are as large as 1,200 acres.

Woodward soils make up about 40 percent of the complex. They are sloping soils in areas leading to the natural drains. Yahola soils make up about 30 percent of the complex and are along the bottoms of the drains. About 20 percent of the complex is Breaks. They are moderately steep and occur between the sloping Woodward soils and the nearly level Yahola soils. The remaining 10 percent consists of small areas of Mansker fine sandy loam, Enterprise very fine sandy loam, Quinlan loam, and Cottonwood loam.

The Woodward soil in this complex has a reddish-brown loam surface layer, about 6 inches thick, that contains free lime. The next layer is reddish-yellow very fine sandy loam about 14 inches thick. The underlying material consists of weakly cemented sandstone and begins at a depth of about 20 inches.

The Yahola soil in this complex has a reddish-brown fine sandy loam surface layer that is about 15 inches thick and contains free lime. The underlying material is friable, yellowish-red fine sandy loam with bedding planes.

Breaks have slopes that range from 5 to 16 percent. The difference in elevation between the top of the breaks or banks and the bottom of the drains is 8 to 30 feet. The soils on the Breaks are similar to those of the Quinlan series.

This mapping unit is used for range. It is not suitable for cultivation. (Capability unit VIe–4; Woodward soils, Mixedland range site; Yahola soils, Loamy Bottomland range site; Breaks, Rough Breaks range site)

Yahola Series

The Yahola series consists of deep, well-drained, friable, calcareous, loamy soils that have bedding planes. The soils are on flood plains of the major streams and their tributaries.

In a representative profile, the surface layer is reddish-brown fine sandy loam about 15 inches thick. The underlying material, to a depth of 60 inches, is yellowish-red fine sandy loam that has bedding planes.

Yahola soils are subject to occasional flooding. Permeability is moderately rapid. Available water capacity is moderate.

Representative profile of Yahola fine sandy loam in a field, 2,798 feet east of Farm Road 1547, at a point 4.55 miles south of the intersection of that road and State Highway 203 in Quail:

A1—0 to 15 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, granular structure; soft, friable; calcareous, moderately alkaline; clear, smooth boundary.

C—15 to 60 inches +, yellowish-red (5YR 4/6) fine sandy loam, dark reddish brown (5YR 3/4) when moist; massive (structureless); slightly hard, friable; common fine pores; bedding planes evident in lower part; thin strata of loamy sand and loam; calcareous, moderately alkaline.

The A horizon range from 6 to 20 inches in thickness and from light reddish brown to dark brown in color. The C horizon is light reddish brown to yellowish red.

Yahola fine sandy loam (Ya).—This nearly level soil is on flood plains of the major streams and their tributaries. Slopes average about 0.4 percent but range to about 1.0 percent. Areas are oblong, have smooth boundaries, and average about 60 acres in size, but some areas are as large as 200 acres.

Included with the soil in mapping are small areas of Colorado loam, Spur clay loam, and Lincoln soils that make up less than 5 percent of any given area.

This soil is used mainly for crops. Runoff from adjacent higher lying soils causes some flooding. (Capability unit IIw–1; Loamy Bottomland range site)

Use and Management of the Soils

This section has several parts. The first is provided for those interested mainly in managing soils for production of cultivated crops. The system of capability grouping is discussed, and management is suggested for the soils in each capability unit. The second part lists the estimated yields, and the third briefly discusses irrigation in the county. The fourth part is provided for those interested in the use of the soils for range. It explains the system of judging native range and suggests management for the range sites in the county. In the fifth part, use of the soils for wildlife is discussed and the wildlife sites are explained. In the sixth part, use of the soils for engineering is discussed. Tables are provided concerning those characteristics of the soils that are significant when they are used for roads, dams, and other structures.

Management of Cropland [2]

In Collingsworth County, climate affects the management of cropland more than any other single factor. The main hazards are low rainfall, severe droughts, high intensity rains, high winds, and hail. The purpose of soil management, then, is to conserve moisture, to protect soils from soil blowing and water erosion, and to maintain soil fertility.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are

[2] By JACK DOUGLAS and ALLEN KING, agronomists, Soil Conservation Service.

used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range or engineering.

In the capability system, all kinds of soil are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

- Class I soils have few limitations that restrict their use. (None in Collingsworth County.)
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (None in Collingsworth County.)

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-7. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

The capability units are not numbered consecutively in Collingsworth County, because not all of the capability units used in a multicounty area of Texas are in this county.

Management by capability units

In the following pages the capability units in Collingsworth County are described and suggestions for use and management of the soils of those units are given. To find the capability classification of any given soil, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT IIce-1

The only soil in this unit is Spur clay loam. This is a deep, nearly level to gently sloping, loamy soil on flood plains. It has a calcareous clay loam surface layer that is easily tilled. Below this layer is clay loam that is moderately permeable. Flooding is a slight hazard on this soil.

This soil is used mainly for crops. The principal cultivated crops are cotton, wheat, and grain sorghum. A small percentage of the acreage is used for pasture or range.

Cropping systems that include wheat or other crops that produce a large amount of residue are well suited to this soil. The residue from such crops helps to control soil blowing, adds organic matter to the surface layer, and helps to maintain good tilth. In some places, diversion terraces and grassed waterways are needed to protect the soil from runoff from higher lying soils. Emergency tillage is needed to help prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IIce-2

The only soil in this unit is Carey loam, 0 to 1 percent slopes. This is a deep, nearly level, loamy soil on uplands. It has a loam surface layer that is easily tilled. The next layer is sandy clay loam that is moderately permeable.

Most of this soil is cultivated. The rest is used for pasture or range. The principal cultivated crops are cotton, wheat, and grain sorghum, but other crops grown in the county are also well suited.

Cropping systems that include cover crops, mulches, or grain sorghum or other crops that produce a large amount of residue are well suited to this soil. The residue from such crops helps to control soil blowing, adds organic matter to the surface layer, and helps to maintain good tilth. In some places, diversion terraces and grassed

waterways are needed to protect this soil from runoff that comes from higher lying soils. Emergency tillage is needed to help prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IIce-3

The only soil in this unit is Colorado loam. This is a deep, nearly level, loamy soil on flood plains along the major streams and their tributaries throughout the county. It has a loam surface layer that is easily tilled. The next layer also is loam and is moderately permeable.

This soil is used mainly for cropland. The principal cultivated crops are cotton, wheat, and grain sorghum.

Cropping systems that include grain sorghum or other crops that produce a large amount of residue are well suited to this soil. The residue helps to control soil blowing. Emergency tillage reduces soil blowing on fields without adequate vegetative cover. In some places, diversion terraces and grassed waterways are needed to control runoff from higher lying soils.

CAPABILITY UNIT IIce-4

This unit consists of deep, nearly level, loamy soils on uplands. These soils have a loam or clay loam surface layer. The next layer is clay loam or silty clay loam that is moderately slowly permeable. Available water capacity is high, but in years of low rainfall, these soils are droughty.

Most areas of the soils are cultivated, but some are used for pasture or range. The principal crops are cotton, wheat, and grain sorghum, but other crops grown in the county are also well suited.

Cropping systems that include wheat or other crops that produce a large amount of residue are well suited to these soils. The residue from such crops helps to control soil blowing, adds organic matter to the surface layer, and helps to prevent surface crusting. In some places, diversion terraces and grassed waterways are needed to protect these soils from water running off higher lying soils. Emergency tillage is needed to reduce soil blowing on fields without adequate vegetative cover.

CAPABILITY UNIT IIe-1

This unit consists of moderately deep to deep, gently sloping, loamy soils. These soils are on uplands. They have a loam or very fine sandy loam surface layer that is easily tilled. The next layer is very fine sandy loam or sandy clay loam that is moderate to moderately rapidly permeable.

Most areas of these soils are cultivated. Cotton, wheat, and grain sorghum are the main crops, but other crops grown in the county are also well suited. Areas not cultivated are used mainly for pasture or range.

Cropping systems that include grain sorghum or other crops that produce a large amount of residue are well suited to these soils. The residue from such crops helps to control soil blowing and water erosion, adds organic matter to the surface layer, and helps to maintain good tilth. Terraces and contour farming are needed to help control water erosion in cultivated fields. Grassed waterways and diversion terraces help to prevent erosion from runoff. Emergency tillage is needed to prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IIe-2

The only soil in this unit is LaCasa silty clay loam, 1 to 3 percent slopes. This is a deep, gently sloping, loamy soil on uplands. It has a silty clay loam surface layer. The next layer is clay loam that is moderately slowly permeable. Available water capacity is high.

Most of this soil is used for crops. The rest is used for range. The main cultivated crops are cotton, wheat, and grain sorghum.

Cropping systems that include wheat or other crops that produce a large amount of residue are well suited to this soil. The residue from such crops helps to control soil blowing and water erosion and helps to prevent surface crusting. Terraces and contour farming are needed to control water erosion in cultivated fields. Grassed waterways and diversion terraces help to prevent erosion from runoff. Emergency tillage can be used to help prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IIw-1

The only soil in this unit is Yahola fine sandy loam. This is a deep, nearly level, loamy soil. It is on flood plains of the major streams and their tributaries throughout the county. It has a calcareous fine sandy loam surface layer that is easily tilled. The underlying material is fine sandy loam and is moderately rapidly permeable. Flooding is a moderate hazard.

This soil is used mainly for crops. A small percentage is used for growing hay or for range. The main cultivated crops are cotton, wheat, and grain sorghum.

Cropping systems that include grain sorghum or other crops that produce a large amount of residue are well suited to this soil. The residue from such crops helps to control soil blowing, adds organic matter, and helps to maintain good tilth. In some places, diversion terraces and grassed waterways are needed to protect this unit from water that runs off higher lying soils. Emergency tillage is needed to help prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IIIe-2

This unit consists of deep, nearly level to gently sloping, loamy soils. These soils are on uplands. They have a loam, clay loam, or silty clay loam surface layer. The next layer of clay loam or silty clay loam tends to impede the movement of water, air, and roots. During the summer or in years of below average rainfall, these soils are droughty.

Most areas of these soils are used for crops, and the rest are used for pasture or range. They are fairly well suited for cultivated crops.

Cropping systems that include wheat or other crops that produce a large amount of residue are well suited to these soils. The residue from such crops helps to reduce soil blowing and water erosion. Terraces and contour farming aid in controlling water erosion in cultivated fields. Grassed waterways and diversion terraces also help to prevent erosion.

CAPABILITY UNIT IIIe-3

This unit consists of shallow to deep, gently sloping, loamy soils. These soils are on uplands. They have a loam or very fine sandy loam surface layer that is easily tilled.

The next layer is very fine sandy loam or sandy clay loam that is moderately to moderately rapidly permeable. Available water capacity is moderate to high.

About 50 percent of the acreage of these soils is cultivated. The other 50 percent is used for pasture or range. Principal crops are cotton, wheat, and grain sorghum.

Cropping systems that include grain sorghum or other crops that produce a large amount of residue are well suited to these soils. The residue from such crops helps to control soil blowing and water erosion, adds organic matter to the surface layer, and helps maintain good tilth. Terraces and contour farming are needed to help control water erosion in cultivated fields. Grassed waterways and diversion terraces help to prevent erosion from runoff. Emergency tillage is needed in control of soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IIIe-4

This unit consists of deep, nearly level to gently sloping, loamy soils. These soils are on uplands. They have a fine sandy loam surface layer that is easily tilled. The next layer of sandy clay loam is moderately permeable. Available water capacity is high.

Most areas of these soils are cultivated. Some areas are used for pasture or range. The principal cultivated crops are cotton, wheat, and grain sorghum.

Cropping systems that include cover crops, mulches, or grain sorghum or other crops that produce a large amount of residue are well suited to these soils. The residue from such crops helps to control soil blowing and water erosion. Terraces and contour farming help to control water erosion in gently sloping areas of cultivated fields. Grassed waterways and diversion terraces aid in controlling erosion from runoff. Emergency tillage is needed to prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IIIe-7

The only soil in this unit is Lutie clay loam, 1 to 3 percent slopes. This is a deep, gently sloping, loamy soil on uplands. It has a clay loam surface layer. The next layer is silty clay loam that is moderately permeable.

About 50 percent of the acreage of this soil is cultivated, and the other 50 percent is used for pasture or range. The main cultivated crops are cotton, wheat, and grain sorghum.

Cropping systems that include wheat or other crops that produce a large amount of residue are well suited to this soil. The residue from such crops helps to control soil blowing and water erosion, adds organic matter to the surface layer, and helps to maintain good tilth. Terraces and contour farming are needed to help control water erosion in cultivated fields. Grassed waterways and diversion terraces help to prevent water erosion. Emergency tillage is needed to help prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IIIe-8

The only soil in this unit is Mansker fine sandy loam, 1 to 3 percent slopes. This is a deep, gently sloping, loamy soil on uplands. It has a fine sandy loam surface layer that is easily tilled. The next layer is loam that is moderately permeable and has calcium carbonate accumulations at a depth of about 22 inches.

This soil is used mainly for crops. A small percentage is used for range. The main cultivated crops are cotton, wheat, and grain sorghum.

Cropping systems that include cover crops, mulches, or grain sorghum or other crops that produce a large amount of residue are well suited to this soil. The residue from such crops helps to control soil blowing and water erosion, adds organic matter to the surface layer, and helps to maintain good tilth. Terraces and contour farming help to control water erosion in cultivated fields. Grassed waterways and diversion terraces reduce erosion from runoff. Emergency tillage is needed to help prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IVe-2

This unit consists of deep, gently sloping to sloping, loamy soils. These soils are on uplands. They have a loam or clay loam surface layer that is easily eroded if not protected. The next layer is silty clay loam or clay loam that is moderately to moderately slowly permeable. Available water capacity is high.

Wheat and grain sorghum are the principal crops. These soils are well suited to range.

An adequate cropping system that protects the soil is one in which wheat or other crops that produce a large amount of residue are grown continuously. Crop residue left on or near the surface helps to protect the soils until the next crop is planted. Terraces and contour farming are needed to help control water erosion on cropland. Grassed waterways and diversion terraces can be used to aid in preventing erosion from runoff. Emergency tillage is needed to help prevent soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IVe-3

This unit consists of deep, gently sloping to sloping, eroded, loamy soils. These soils of the uplands have a fine sandy loam or loam surface layer that is easily tilled. In some places the original surface layer has been entirely removed through erosion, and this has exposed the next layer. The next layer ranges from sandy clay loam to silty clay loam and is moderately to moderately slowly permeable.

These soils are used for crops, but they are well suited to pasture or range. Wheat and grain sorghum are suitable crops.

Cropping systems that include crops that produce a large amount of residue are well suited to these soils, and so is permanent vegetation. Crop residue helps to control erosion. Terraces and contour farming are needed to help control water erosion in cultivated fields. Grassed waterways and diversion terraces help to prevent erosion from runoff. In fields without adequate vegetative cover, emergency tillage is needed to help prevent soil blowing.

CAPABILITY UNIT IVe-4

The only soil in this unit is Miles fine sandy loam, 3 to 5 percent slopes. This is a deep, gently sloping, loamy soil on uplands. It has a fine sandy loam surface layer. The next layer is sandy clay loam that is moderately permeable.

This soil is used for crops. It is also well suited to pasture or range. Cotton, wheat, and grain sorghum are the principal cultivated crops.

Cropping systems that include cover crops, mulches, or grain sorghum or other crops that produce a large amount of residue are well suited to this soil. The residue from such crops helps to control soil blowing and water erosion. Terraces and contour farming are needed in the control of water erosion in cultivated fields. Grassed waterways and diversion terraces help to prevent erosion from runoff. Emergency tillage is needed to help control soil blowing in fields without adequate vegetative cover.

CAPABILITY UNIT IVe-5

The only soil in this unit is Mansker fine sandy loam, 3 to 5 percent slopes. This is a deep, gently sloping, loamy soil on uplands. It has a calcareous fine sandy loam surface layer. Its next layer is loam that is moderately permeable and has calcium carbonate accumulations.

This soil is cultivated, but it is also well suited for range. Grain sorghum and wheat are the principal crops.

Cropping systems that include crops such as wheat or grain sorghum that produce a large amount of residue are well suited to this soil. The residue adds organic matter to the surface, improves tilth, and reduces soil blowing and water erosion. Where the soil is cultivated, a complete terrace system and contour farming are needed to help control water erosion. Diversion terraces and grassed waterways are needed to help prevent erosion from runoff. Emergency tillage can be used to help prevent soil blowing where vegetative cover is inadequate.

CAPABILITY UNIT IVe-6

The only soil in this unit is Miles loamy fine sand, 0 to 3 percent slopes. This is a deep, nearly level to gently sloping soil on uplands. It has a loamy fine sand surface layer, and the next layer is moderately permeable sandy clay loam. The available water capacity is high.

About 50 percent of the acreage of this soil is cultivated, and the other 50 percent is used for range. The principal cultivated crops are cotton and grain sorghum.

Cropping systems that include cover crops, mulches, or crops, such as grain sorghum, that produce a large amount of residue are well suited to this soil. The residue from such crops is needed to help control soil blowing and water erosion, and it provides a regular supply of organic matter. Contour farming and terraces help to control water erosion in gently sloping cultivated areas. Diversion terraces and grassed waterways aid in preventing erosion from runoff. Emergency tillage is needed to help prevent soil blowing on fields during periods of critical blowing. Deep plowing also helps to control soil blowing.

CAPABILITY UNIT IVe-9

The only soil in this unit is Springer fine sandy loam, 3 to 5 percent slopes. This is a deep, gently sloping, loamy soil on uplands. It has a fine sandy loam surface layer. The next layer is moderately rapidly permeable fine sandy loam.

This soil is cultivated, but it is also well suited to range. Cultivated crops are cotton and grain sorghum.

Cropping systems that include crops, such as grain sorghum, that produce a large amount of residue are needed to help control soil blowing and water erosion and to provide regular additions of organic matter. Emergency tillage is needed where vegetative cover is inadequate. Grassed waterways and diversion terraces help to control erosion from runoff.

CAPABILITY UNIT IVe-11

The only soil in this unit is Springer loamy fine sand, undulating. This is a deep, gently undulating, sandy soil on uplands. It has a loamy fine sand surface layer. The next layer is moderately rapidly permeable fine sandy loam. The available water capacity is moderate.

The soil in this unit is used mainly for range, but some areas are cultivated. Grain sorghum is the main cultivated crop. Fertilization is needed to produce good crops.

Cropping systems that include crops producing a large amount of residue help to control soil blowing. The residue from grain sorghum or other crops needs to be left on the surface for protection against soil blowing. Where the plant cover is inadequate, emergency tillage is needed during periods of critical blowing.

CAPABILITY UNIT Vw-1

This unit consists of deep, nearly level to gently sloping clay loams and loams. These soils are on flood plains of the major streams and their tributaries. They receive runoff from surrounding higher lying soils, and they are subject to frequent flooding, washing, and deposition of new soil material.

These soils are not suitable for cultivation but are used for range and growing hay.

CAPABILITY UNIT Vw-2

The only soils in this unit are Lincoln soils. They are deep and nearly level to gently sloping, and they are on flood plains mainly along the creeks and their tributaries. They receive runoff from surrounding higher lying soils and are subject to frequent flooding, washing, and deposition of new soil material.

These soils are not suitable for cultivation but are used for range and growing hay.

CAPABILITY UNIT VIe-3

The only soil in this unit is Mansker fine sandy loam, 5 to 8 percent slopes. This is a well-drained, sloping, loamy soil on uplands. It has a fine sandy loam surface layer. It is susceptible to soil blowing and water erosion if not protected. Available water capacity is high.

This soil is not suitable for cultivation but is used for range.

CAPABILITY UNIT VIe-4

This unit consists of Breaks, a land type, and loamy soils that range from very shallow to deep and from sloping to moderately steep. These soils are on uplands. They have a surface layer of fine sandy loam to clay loam. The next layer ranges from fine sandy loam to silty clay loam. The permeability of these soils is moderate to moderately rapid. Available water capacity ranges from low to high.

The soils in this unit are used for range. They are not suitable for cultivation.

CAPABILITY UNIT VIe-5

The only soil in this unit is Springer fine sandy loam, 5 to 8 percent slopes. This is a deep, sloping, loamy soil on uplands. It has a fine sandy loam surface layer over a fine

sandy loam lower layer. Permeability is moderately rapid. Available water capacity is high.

Slope and the hazard of erosion make this soil unsuitable for cultivation, but it is used for range.

CAPABILITY UNIT VIe-6

This unit consists of deep, gently sloping, sandy soils on uplands. These soils have a loamy fine sand surface layer over lower layers of fine sandy loam to sandy clay loam. Fence lines and tree rows in some areas have accumulations of fine sand, 5 to 20 feet deep, that are a result of soil blowing. Permeability of the soils is moderate to moderately rapid. Available water capacity ranges from moderate to high.

These soils are not suitable for cultivation, but they are suitable for range.

CAPABILITY UNIT VIe-7

This unit consists of Blown-out land and deep, gently sloping to sloping, sandy soils. These soils occupy uplands. They have a loamy fine sand to fine sand surface layer over lower layers of fine sandy loam to sandy clay loam. Some of the soils are severely eroded, and Blown-out land occurs throughout the unit. In some areas along fence lines, soil blowing has resulted in accumulations of fine sand 3 to 20 feet deep. Permeability of the soils ranges from moderate to rapid. Available water capacity ranges from moderate to low.

These soils are used for range. They are not suitable for cultivation.

CAPABILITY UNIT VIIe-1

The only soil in this unit is Tivoli fine sand. This is a deep, loose, sandy soil. It is on duned topography and has a fine sand surface layer. The next layer is also fine sand. The available water capacity is low. Permeability is rapid.

This soil is not suitable for cultivation and is used for range.

CAPABILITY UNIT VIIs-1

This unit consists of the Ector-LaCasa complex. These soils are on uplands and are very shallow to deep, calcareous, gently sloping to sloping, and loamy. The Ector soils have a gravelly loam surface layer that abruptly overlies platy dolomitic limestone. The LaCasa soils have a calcareous silty clay loam surface layer and lower layers of moderately slowly permeable clay loam.

These soils are not suitable for cultivation and are used for range.

CAPABILITY UNIT VIIs-2

Only the Rough broken land-Woodward complex is in this unit. It occupies steep to very steep, dissected areas throughout the county. Small patches of loamy soils occupy foot slopes and mesas in association with the steeper areas of Rough broken land.

This complex is not suitable for cultivation and is of limited use for grazing. It is used for wildlife habitat.

Estimated Yields

Table 2 gives the estimated average yields per acre on the soils suitable for cultivation under dryland farming for the three principal crops grown in the county—cotton, grain sorghum, and wheat. The yields shown are for a high level of management and are based on the experience of farmers and on the observations of farm workers in the county.

TABLE 2.—*Estimated average yields per acre of the principal crops grown under a high level of management on the soils suitable for cultivation*

[A dashed line indicates that the crop is not suited to, or is not commonly grown on, the soil specified]

Soil	Cotton lint	Grain sorghum	Wheat
	Lb.	*Bu.*	*Bu.*
Abilene clay loam, 0 to 1 percent slopes	300	35	20
Abilene clay loam, 1 to 3 percent slopes	250	30	15
Carey loam, 0 to 1 percent slopes	300	30	20
Carey loam, 1 to 3 percent slopes	300	30	20
Carey loam, 3 to 5 percent slopes	225	25	15
Colorado loam	400	45	25
Enterprise very fine sandy loam, 1 to 3 percent slopes	300	35	20
Enterprise very fine sandy loam, 3 to 5 percent slopes	250	30	15
LaCasa silty clay loam, 1 to 3 percent slopes	300	35	20
LaCasa silty clay loam, 3 to 5 percent slopes	225	30	15
Lutie clay loam, 1 to 3 percent slopes	225	30	15
Lutie clay loam, 3 to 6 percent slopes	------	25	10
Mansker fine sandy loam, 1 to 3 percent slopes	225	25	15
Mansker fine sandy loam, 3 to 5 percent slopes	------	20	10
Miles and Altus soils, 0 to 1 percent slopes	300	25	20
Miles fine sandy loam, 1 to 3 percent slopes	250	25	20
Miles fine sandy loam, 3 to 5 percent slopes	------	15	15
Miles fine sandy loam, 3 to 5 percent slopes, eroded	------	10	10
Miles loamy fine sand, 0 to 3 percent slopes	225	25	15
Springer fine sandy loam, 3 to 5 percent slopes	170	15	10
Springer loamy fine sand, undulating	------	20	------
Spur clay loam	350	30	20
Wichita loam, 0 to 1 percent slopes	300	30	20
Wichita loam, 1 to 3 percent slopes	250	25	15
Wichita-Lutie loams, 0 to 2 percent slopes	225	20	15
Wichita-Lutie loams, 2 to 6 percent slopes	175	15	10
Wichita-Lutie loams, 2 to 6 percent slopes, eroded	------	15	10
Woodward loam, 1 to 3 percent slopes	250	25	15
Woodward loam, 3 to 5 percent slopes	200	20	10
Woodward-Quinlan loams, 2 to 5 percent slopes	200	20	10
Yahola fine sandy loam	350	25	20

Yields under dryland farming depend largely on the supply of moisture that is available in the soils at planting time and during the growing season. Generally, the higher the rainfall during the growing season, the higher the yields.

Consistently high yields depend on good soil management, as well as on moisture and high fertility. The soil used within its capabilities and managed according to its needs will produce the best average yields. The required management consists of using terraces and contour farming, where needed, as well as soil-improving crops, cover crops, and crops that produce a large amount of residue.

The yields shown in table 2 reflect a high level of management. The estimated yields are an average of yields obtained over a period of 10 to 20 years and cannot be expected every year. In some years they will be higher than the average; in others they will be lower.

The following are practices used under the high level of management:

1. Rainfall is conserved by using all necessary conservation measures, including a properly maintained system of terraces, contour farming, and stubble-mulch tillage.
2. Crop residue is managed for effective control of erosion.
3. The fertility of the soils is maintained by timely application of fertilizer, based on soil tests and the needs of the crop to be grown, and by growing and managing adapted soil-improving crops.
4. Soil tilth is adequately maintained by using a cropping sequence that insures an adequate supply of organic matter in the surface layer; by avoiding tillage and harvesting operations when the soils are wet; and by tilling only when it is necessary to prepare the seedbed or to control weeds.
5. Insects, diseases, and weeds are controlled by using suitable methods at the proper time.

Irrigation of the Soils

Irrigation in Collingsworth County is of minor importance. There were approximately 25 irrigation wells in the county prior to 1954. Since that time about 75 wells have been drilled, and approximately 11,500 acres were being irrigated at the time of this survey.

Most of the irrigated areas are near the Dodson, Samnorwood, and Lutie communities.

All water used for irrigation comes from deep wells. Most of the existing wells are 100 to 300 feet deep; a few are deeper. In many areas of the county where soils are suitable for irrigation, water is not available. In other areas the available water is of such low quality that, if used, it will harm the crop or soil. The main harmful salts in the water of Collingsworth County are sodium chloride (table salt), sodium sulfate (Glauber's salt), magnesium sulfate (Epsom salt), and sodium bicarbonate (baking soda). Other salts present in large amounts, but not harmful, are calcium sulphate (gypsum), calcium carbonate, and magnesium carbonate.

Two types of irrigation systems are used in the county—row and sprinkler. Row irrigation requires nearly level soils, and land leveling is generally necessary before this system can be used. Sprinkler irrigation is satisfactory on most sloping soils in the county and is generally used on the more sandy soils.

Yields under irrigation can be expected to be higher than those under nonirrigated farming. More information on irrigation can be obtained from representatives of the Soil Conservation Service who serve the Salt Fork Soil and Water Conservation District.

Use of the Soils for Range[3]

Native rangeland covers about 55 percent of Collingsworth County. There are about 96 ranch operating units. Most of the livestock are cows and calves. Many ranchers, however, supplement their operations with winter stockers or carry-over calves. Almost all the livestock units include some cropland that is used to produce supplemental forage. This additional forage is normally annual grazing crops, or harvested and stored as silage, bundles, or hay. Crops used for supplemental forage are small grains, sudangrass, grain sorghum, and johnsongrass. Because the condition of livestock at the time of sale is affected by the quality of the rangeland forage, the success of the enterprise depends on the way ranchers manage their grassland.

The native rangeland in Collingsworth County has been heavily grazed for several generations. As a result, the Deep Hardland range site is now mostly buffalograss and blue grama. The Mixedland range site is now buffalograss, blue grama, and three-awn. Mesquite is invading both of these sites. On the sandy soils, some bluestem is still growing but the dominant plants are dropseed, three-awn, and shin oak. Because of inaccessibility, the Rough Breaks range site is currently producing vegetation similar to the original vegetation before the introduction of livestock.

Range sites and condition classes

Soils differ in their capacity to produce grass and other plants suitable for grazing. The soils that produce about the same kind and amount of forage, if the ranges are in similar condition, make up what is called a range site.

Range sites are kinds of rangeland that differ from each other in their ability to produce a significant difference as to kinds and amounts of vegetation. A significant difference is one that is great enough to influence the grazing use and the management needed to maintain or improve the present vegetation. The most productive group of forage plants on a range site is generally the original combination of plants. In many areas the present potential of the range is considerably less than the original potential. Erosion is a principal cause for this permanent loss in productivity.

Decreasers are species in the potential plant community that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock.

Increasers are species that increase in relative amount as the more desirable plants are reduced by close grazing. They are commonly shorter, and some are less palatable to livestock than decreasers.

Invaders are plants that cannot withstand the competition for moisture, nutrients, and light in the potential plant community. Hence, they come in and grow along with the increasers after the climax vegetation has been reduced by grazing. Many are annual weeds; some are shrubs that have some grazing value; but others have little value for grazing.

Four range condition classes are used to indicate the degree of departure from the native, or original, vegetation brought about by grazing or other use. They show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there. Range condition is judged according to standards that apply to the particular kind of range site and its climate.

A range is in *excellent* condition if 76 to 100 percent of the present vegetation is of the same kind as in the origi-

[3] By JOE B. NORRIS and H. M. BELL, range conservationists, Soil Conservation Service.

nal stand. It is in *good* condition if the percentage is between 51 and 75, in *fair* condition if the percentage is between 26 and 50 percent, and in *poor* condition if the percentage is less than 25.

The potential production of forage depends on the characteristics of the range site. Current forage production depends on the range condition and the moisture that the plants get during their growing season.

The main objective of good range management is to keep rangeland in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected. A major problem in managing the range, however, is recognizing important changes in the kind of cover on a range site. These changes take place gradually and may be overlooked or misinterpreted. Growth encouraged by heavy rainfall may indicate that the range is in good condition when actually the cover is weedy and the long-time trend is toward lower production. However, some rangeland that has been closely grazed for relatively short periods, under careful supervision, may have a degraded appearance that temporarily conceals its quality and ability to recover.

Descriptions and interpretations of range sites

In this subsection, the 11 range sites in Collingsworth County are described. The composition of the potential plant community is given and the principal invaders are named. Also given is an estimate of the total annual herbage yield for each site when it is in excellent condition.

In several areas throughout the county, the soils are so intermingled that mapping them separately was impractical. Therefore, they were mapped in soil complexes. In this county the soils in a complex commonly are placed in different range sites. To find the site in which a given soil has been placed, refer to the "Guide to Mapping Units" at the back of this survey.

LOAMY BOTTOMLAND RANGE SITE

This site consists of the lowlands along rivers, intermittent streams, and small draws (fig. 15).

The soils are subject to overflow, and they receive runoff from adjacent lands. Although they are sometimes flooded, they are under water for only short periods. Any damage to vegetation is caused by sedimentation rather than wetness. This is one of the better range sites in the county because of the extra water received as runoff. In dry periods it sometimes provides the only green forage on the range.

The climax vegetation varies from place to place, depending on the origin of the alluvial deposits. About 70 percent consists of original decreasers—big bluestem,

Figure 15.—**Small draw occupied by Spur and Colorado soils. The range site is Loamy Bottomland.**

455-234—73——3

sand bluestem, little bluestem, Indiangrass, switchgrass, Canada wildrye, and side-oats grama. Climax increasers are western wheatgrass, vine-mesquite, silver bluestem, blue grama, meadow dropseed, and, in alkali spots, alkali sacaton. A few woody plants, chiefly elm, hackberry, and cottonwood, are in the climax vegetation on some of the bottom lands.

If the climax vegetation is not maintained, the site is invaded by noxious plants that grow from seed washing in from uplands. They include sunflower, cocklebur, buffalo-bur, hairy caltrop, common broomweed, croton, thistle, sandbur, sand dropseed, three-awn, windmillgrass, buffalograss, Texas grama, hairy tridens, perennial forbs, and inland saltgrass in saline areas. The principal woody invaders are saltcedar, mesquite, lotebush, tasajillo, and pricklypear.

The trend in range condition is generally downward for this site throughout the county. Some areas, however, have been maintained as meadows. The site responds to brush control and range seeding when used to reestablish a stand. Careful management can maintain the range in good condition.

This site is capable of high production if it is not overwashed by shale or clay sediments. Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 2,000 pounds per acre in unfavorable years to 3,500 pounds per acre in favorable years. Livestock prefer this site for grazing.

SANDY BOTTOMLAND RANGE SITE

This site consists of nearly level to gently sloping soils along stream beds (fig. 16). Some areas of this site are subject to flooding and deposition. If unprotected by plant cover, the site is subject to shifting, scouring, and gullying by soil blowing and water erosion.

The climax vegetation is mid and tall grasses. Indiangrass, switchgrass, and sand bluestem were dominant on the site in its original condition. These grasses, together with some stands of eastern grama and prairie cordgrass, make up the potential plant community. Other decreasers are side-oats grama, little bluestem, Canada wildrye, Texas bluegrass, and big sandreed. About 70 percent of the total original vegetation was made up of these species. A few woody plants such as sand plum, cottonwood, willow trees, sand sagebrush, and skunkbush were found under climax conditions.

Figure 16.—**Large area of Lincoln soils. The range site is Sandy Bottomland.**

Deterioration of the plant cover caused by overgrazing results in an increase of such increasers as vine-mesquite, meadow dropseed, three-awn, sand dropseed, and blue grama. Where the soils are saline, alkali sacaton increases. Further deterioration of the climax stand results in an invasion of gummy lovegrass, annual three-awn, tumble lovegrass, low-growing paspalums, purple sandgrass, numerous annual grasses, and inland saltgrass in salty areas. Woody invaders are saltcedar, yucca, and groundsel.

The trend in range condition on this site is downward because of heavy grazing, soil blowing and water erosion, and invasion by woody plants. Once the climax vegetation is grazed out, this productive site drops immediately in its ability to produce forage. The condition of the range can be improved by brush control and range seeding if the site is adequately protected from erosion during the period of treatment.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 2,000 pounds per acre in unfavorable years to 3,500 pounds per acre in favorable years.

SANDYLAND RANGE SITE

This site consists of nearly level to gently sloping soils (fig. 17) that have a moderate to high available water capacity. If they are not protected, they are susceptible to soil blowing. If they are properly managed, they will produce a good stand of mid and tall grasses.

About 75 percent of the plant community on this site consists of climax decreasers—sand bluestem, switchgrass, Indiangrass, little bluestem, Canada wildrye, sand lovegrass, side-oats grama, and Texas bluegrass. Approximately 25 percent of the plants are climax increasers—silver bluestem, sand dropseed, hairy grama, blue grama, and perennial three-awn. Small amounts of other plants, such as shin oak, sand plum, and sand sagebrush, were present in the climax vegetation.

Any deterioration in this site results in a rapid increase in woody plants, and this is the trend in most areas. As deterioration continues, small soapweed almost completely replaces the better grasses by shading them and by using all the available moisture. Invading grasses are annual three-awn, fringed signalgrass, tumble windmillgrass, gummy lovegrass, red lovegrass, tumble lovegrass, low-growing paspalums, and purple sandgrass. Invading forbs are showy partridgepea, Texas sleepydaisy, common ragweed, tumble ringwing, annual wild-buckwheat, rosering gaillardia, prairie sunflower, woolywhite, beebalm, pricklepoppy, curlycup gumweed, camphorweed, sandlily, Riddell groundsel, and stillingia.

The Sandyland site will respond to control of brush and weeds, provided this treatment is supplemented with deferred grazing until the desirable grasses recover. Good range management that ensures proper use of the key grasses will assure maintenance of such improvement for a period of 7 to 12 years. Thereafter, follow-up treatment may be necessary.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,800 pounds per acre in unfavorable years to 3,300 pounds per acre in favorable years.

Figure 17.—Gently sloping relief of Sandyland range site. The soil is Springer loamy fine sand, hummocky.

DEEP SAND RANGE SITE

This site consists of gently sloping to sloping soils and stabilized dunes. The site is hummocky adjacent to major streams. This site is susceptible to soil blowing if it is unprotected by vegetation. Where it is protected, moisture intake is high and there is little runoff. The site deteriorates rapidly under continued heavy grazing but responds favorably to good management.

The climax vegetation is predominantly tall grasses and lesser amounts of mid grasses. Decreasers comprising some 75 percent of the original vegetation include sand bluestem, Indiangrass, little bluestem, switchgrass, sand lovegrass, giant dropseed, and needle-and-thread. Important increasers are side-oats grama, silver bluestem, hairy grama, sand dropseed, and perennial three-awn. Along with these increasers are such woody plants as sand plum and skunkbush. Invading grasses are annual three-awn, fringed signalgrass, tumble windmillgrass, gummy lovegrass, red lovegrass, tumble lovegrass, low-growing paspalums, and purple sandgrass. The dominant invading forbs are showy partridgepea, Texas sleepydaisy, common ragweed, tumble ringwing, annual buckwheat, rose-ring gaillardia, prairie sunflower, woolywhite, beebalm, pricklypoppy, curlycup gumweed, Riddell groundsel, and stillingia. Most areas of the Deep Sand site are infested with sand sagebrush, shin oak, and other woody plants.

The trend in range condition continues to be downward except where brush control treatment supported by good range management has been applied. This site responds to treatment, but it must be carefully applied and the site managed carefully to prevent soil blowing before the establishment of a suitable grass stand. Range seeding is generally not successful, because the soils are unstable. Natural recovery of grasses is generally adequate if brush is controlled and management is good.

Where the site is in excellent condition, the total yield of air-dry herbage ranges from 1,700 pounds per acre in unfavorable years to 3,400 pounds per acre in favorable years.

DEEP HARDLAND RANGE SITE

The site consists of mostly smooth, nearly level to sloping soils on upland plains. It is accessible to livestock and is favored for grazing. The soils of the site are deep, and they are moderately slowly permeable to water and roots but have a high available water capacity. In many places the intake of moisture is further reduced by surface crusting and by the compacted layer, or hoof pan, caused by trampling.

The climax vegetation on this site consists of mid and short grasses. About 70 percent is made up of decreasers —side-oats grama, blue grama, and Arizona cottontop.

Plains bristlegrass is present to a limited extent, and western wheatgrass and vine-mesquite grow in depressions. Little bluestem ordinarily does not grow on this site except in areas containing gypsum or on gravelly or rocky soils. Climax increasers make up about 30 percent of the climax vegetation. Important species are buffalograss and silver bluestem.

Continuous overgrazing results in an immediate decrease in side-oats grama followed by a decrease in blue grama. Buffalograss then increases and becomes dominant. Further deterioration of the range results in invasion by perennial three-awn, hairy tridens, sand dropseed, tumblegrass, pricklypear, mesquite, lotebush, and numerous annuals. Large areas of this site are in poor condition and are bare. These areas generally are invaded by annuals in the spring if the supply of moisture is good. The most common of these annuals are Texas filaree, evax, various plantains, bladderpod, plains greenthread, bitterweed actinea, snow-on-the-mountain, common broomweed, little barley, and Japanese brome. The common invading perennial forbs on this site are western ragweed, onion, silverleaf nightshade, cutleaf germander, and Dakota verbena.

This site is capable of only limited production. A large amount of litter and cover is necessary to reduce surface crusting and to help prevent erosion. Where the range is in poor condition, recovery is slow because of crusted soils, poor moisture intake of the soils, and infestation of mesquite.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,500 pounds per acre in unfavorable years to 2,300 pounds per acre in favorable years.

MIXEDLAND RANGE SITE

This site consists of nearly level to steep soils on uplands (fig. 18) throughout the county.

About 70 percent of the climax vegetation consists of decreaser grasses. Side-oats grama and blue grama are the dominant species. In lesser amounts are little bluestem, Arizona cottontop, plains bristlegrass, and, along the larger drains, Canada wildrye, switchgrass, and western wheatgrass. For the most part, little bluestem is confined to isolated areas where moisture is favorable, such as some areas of shallow soils in which seepage occurs in wet periods, and areas containing gypsum. Approximately 30 percent of the climax vegetation consists of increasers—buffalograss, hairy grama, sand dropseed, silver bluestem, and, along drains, meadow dropseed.

Any deterioration in the vegetation results in an immediate decrease in side-oats grama, followed by an increase in blue grama and buffalograss. If the site is continuously

Figure 18.—**Gently rolling area of Quinlan-Woodward loams. The relief and vegetation here are typical of the Mixedland range site.**

overgrazed, the range vegetation soon consists almost entirely of buffalograss and numerous invading forbs, together with blue grama in protected areas. The chief invading grasses are red grama, Texas grama, six-weeks grama, Japanese brome, tumble windmillgrass, hooded windmillgrass, gummy lovegrass, little barley, tumblegrass, and hairy tridens. Woody invaders are mesquite, pricklypear, tasajillo, and small soapweed.

Although the trend in range condition on the Mixedland site is generally downward, recovery may be expected from improved range management and from brush and weed control where needed. This site can be successfully seeded either as range or cropland converted to rangeland.

This site can produce satisfactory forage if it is in good or excellent condition. If adequate plant cover and litter are not maintained, the site deteriorates because of soil blowing and water erosion.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,600 pounds per acre in unfavorable years to 2,600 pounds per acre in favorable years.

SHALLOW REDLAND RANGE SITE

This site consists of gently sloping to sloping soils in areas of red-beds material. This site is in association with the Deep Hardland range site.

The climax vegetation consists mostly of mid and short grasses. Climax decreasers, of which side-oats grama is the dominant species, constitute about 65 percent of the plant community. Other important decreasers are vine-mesquite and little bluestem. Sand bluestem and Indiangrass are in areas that have northerly and easterly exposures. In these areas moisture is more favorable because of lower temperatures and less evaporation. Important increasers common to the site are blue grama, buffalograss, silver bluestem, hairy grama, three-awn, and sand dropseed. Forbs in the climax vegetation are ground-plum, milkvetch, dalea, prairie clover, scurfpea, heath aster, engelmanndaisy, dotted gayfeather, penstemon, sagewort, and gaura. These forbs are important indicators in determining trends in the condition of the range. Shrubs, such as acacia, mimosa, vine ephedra, agarita, and skunkbush, are present to a limited extent.

The chief woody invaders are mesquite, grassland croton, pricklypear, lotebush, and small soapweed. If there is a nearby source of seed, redberry juniper also invades this site. Common invading perennial grasses are hairy tridens, Texas grama, red grama, and tumblegrass. The chief invading forbs are broom snakeweed, false broomweed in spots containing gypsum, plains actinea, gray goldaster, wavyleaf thistle, hoary blackfoot, threadleaf groundsel, and Texas stillingia. Other common invading forbs are common broomweed, bitterweed actinea, one-seed croton, Texas filaree, evax, plantain, plains greenthread, and bladderpod.

This site will respond to mechanical control of brush on the more gentle slopes where the soil is deeper. Seeding may be done by scattering seed of adapted species where the soil is disturbed in brush-control operations. Recovery of deteriorated range on this site is ordinarily slow.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,200 pounds per acre in unfavorable years to 2,000 pounds per acre in favorable years.

ROUGH BREAKS RANGE SITE

This site is intermingled with other sites in the county. It generally consists of short, steep slopes (fig. 19), and some areas are inaccessible to cattle and horses.

The climax vegetation consists of such decreasers as side-oats grama, little bluestem, and blue grama. Switchgrass, sand bluestem, Indiangrass, and Canada wildrye are in places where moisture is favorable. Increasers, amounting to 30 percent of the total original vegetation, consist of hairy grama, perennial three-awn, slim tridens, and sand dropseed. Woody increasers on the slopes are redberry juniper, feather dalea, skunkbush, and catclaw acacia. Important invaders are Texas grama, hairy tridens, sand muhly, and numerous annuals.

If use is heavy and prolonged, these steep slopes lose their protective vegetative cover and erosion is accelerated. Under such conditions soil loss is severe. Intensive management and protection against soil losses are important.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 500 pounds per acre in unfavorable years to 900 pounds per acre in favorable years.

SANDY LOAM RANGE SITE

This site consists of nearly level to moderately steep soils on upland plains.

This site supports a wide variety of vegetation. Because the surface layer is fine sandy loam, even a light rain penetrates deeply and is used by plants effectively. However, hoof pans and surface crusting form where these soils are unprotected by plant cover.

This mid-grass site produces such climax decreasers as side-oats grama, little bluestem, Arizona cottontop, and plains bristlegrass. Small amounts of vine-mesquite, sand lovegrass, and needle-and-thread normally are in areas that have more favorable moisture. Decreasers make up about 70 percent of the climax vegetation.

The principal increasers are buffalograss, blue grama, sand dropseed, perennial three-awn, hairy grama, and silver bluestem. Woody increasers that make up 5 percent of the climax vegetation in some areas are sand sagebrush, agarito, skunkbush, and mimosa. Invaders are broom snakeweed, western ragweed, mesquite, pricklypear, sand muhly, and annuals.

Because this site is accessible to livestock and produces nutritious forage, it receives heavy and continuous grazing use unless it is protected by good management. The trend in range condition is generally downward throughout the county. This site responds to brush control and range seeding.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,800 pounds per acre in unfavorable years to 2,800 pounds per acre in favorable years.

GYPLAND RANGE SITE

This site consists of soils that are high in content of gypsum (fig. 20). The gypsum may lie below the surface of the soil in solid strata, on the surface as blisters of friable particles, or in platy crystalline form. In some

Figure 19.—**Short, steep slopes of Rough Breaks range site. The site is in excellent condition, and the dominant grass is side-oats grama. The soils are Rough broken land and Woodward loams.**

areas limestone is interspersed with, or adjacent to, the soils of the site.

The amount of gypsum in the soil directly affects the kind and amount of vegetation. Except in areas of almost pure gypsum, the climax vegetation is mid and tall grasses. Climax grasses are side-oats grama, little bluestem, and sand bluestem. In places where the content of gypsum is 75 percent or higher, vegetation is sparse and side-oats grama (a decreaser) and hairy grama (an increaser) are dominant. Other decreasers on the site include blue grama, Indiangrass, switchgrass, vine-mesquite, plains bristlegrass, and Arizona cottontop. Decreasers make up approximately 60 percent of the climax vegetation.

Increasers on this range site are hairy grama, buffalograss, slim or rough tridens, riverchon panicum, black grama, silver bluestem, sand dropseed, and perennial three-awn. Also on the site are dotted gayfeather and black or feather dalea. Invaders are false broomweed, mesquite, redberry juniper, yucca, catclaw, Texas grama, hairy tridens, and numerous annuals.

The range condition of this site is influenced less by grazing than by the gypsum content and other related physical and chemical conditions of the soil. Range treatment practices have little effect on the Gypland range site.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 500 pounds per acre in unfavorable years to 1,100 pounds per acre in favorable years.

VERY SHALLOW RANGE SITE

This site consists of gently sloping to sloping soils that generally have on their surface small rocks and limestone rocks, gravel, or caliche. Where this site is unprotected by vegetation, the sloping areas are susceptible to water erosion.

Many kinds of plants make up the climax vegetation on this site, but their density is sparse. Side-oats grama is the dominant grass, and the site has the appearance of a mid grass site. Other decreasers are blue grama, Arizona cottontop, and little bluestem. On north-facing slopes and in places where moisture is more favorable are sand bluestem, Indiangrass, vine-mesquite, plains bristlegrass, and other desirable grasses. Decreasers make up about 70 percent of the climax vegetation. The increasers include hairy grama, black grama, buffalograss, silver bluestem, sand dropseed, perennial three-awn, and slim or rough tridens. Invaders include hairy tridens, Texas grama, red grama, sand muhly, tumblegrass, mesquite, pricklypear, lotebush, small soapweed, and redberry juniper.

Figure 20.—Gypland range site in an area of Cottonwood soils in the Lutie-Quinlan-Cottonwood complex.

The range condition of most of the Very Shallow range site is poor. Because the soils are shallow, available moisture is limited, and the response to grazing management is slow.

Where the site is in excellent condition, the total annual yield of air-dry herbage ranges from 600 pounds per acre in unfavorable years to 1,500 pounds per acre in favorable years.

Wildlife

Most of the soils of Collingsworth County are suited to, and support, one or more species of wildlife.

Each species of wildlife has a definite requirement for food, cover, and water. If one or more of these requirements is lacking, the wildlife population diminishes or disappears. Therefore, for the preservation of wildlife it is necessary to preserve or develop wildlife habitats. Some species of wildlife spend most or all of their time in brush or wooded areas; others prosper in open farmlands; and many require a water habitat. Technicians of the Soil Conservation Service assisting the Salt Fork Soil and Water Conservation District maintain current technical guides for each important species of wildlife and fish and for each significant food or cover plant suited to the various soils and surface waters in the county. Information on developing wildlife habitat and managing fish ponds can also be obtained from the Texas Agricultural Extension Service and from the Texas Parks and Wildlife Department.

Wildlife sites

In this subsection the soils in Collingsworth County are placed in four wildlife sites, each of which consists of one or more soil associations. The soil associations are shown on the general soil map at the back of this survey and are described in the section "General Soil Map."

WILDLIFE SITE 1

This site consists mainly of soils in the Miles-Springer soil association. These are deep, nearly level to sloping, predominantly sandy soils. The native vegetation is mainly mid and tall grasses, such as side-oats grama, little bluestem, sand bluestem, Indiangrass, switchgrass, and sand dropseed. Woody species are cottonwood and willow trees, skunkbush, and sand sagebrush. This site provides excellent food, cover, and water for wildlife. Windbreaks also provide cover and food on this site.

The principal mammals on this site are rabbit, coyote, skunk, bobcat, oppossum, badger, and raccon. The principal birds are quail, dove, duck, geese, and songbirds.

WILDLIFE SITE 2

This site is made up of soils in the Miles-Carey soil association. These soils are nearly level to gently sloping loams and fine sandy loams on uplands. Most areas of these soils are cultivated, but there are scattered areas where rangeland is intermixed with the cropland. Native vegetation is mainly blue grama, side-oats grama, buffalograss, sand dropseed, hairy tridens, silver bluestem, and three-awn. Mesquite and yucca are the main woody plants. Food is plentiful on this site during summer but is sometimes limited during winter. Sufficient cover is not always available; however, this is a fair site for wildlife if it is properly managed.

The principal mammals on this site are rabbit, coyote, and skunk. The principal birds are dove, quail, duck, and songbirds.

WILDLIFE SITE 3

This site consists mainly of soils in the Wichita-Lutie soil association. The soils are deep and nearly level to sloping, and they occur on uplands. The soils are mostly in rangeland that is intermixed with cropland. The rangeland is mainly confined to the steeper slopes and shallower soils. Native vegetation is mainly buffalograss, blue grama, side-oats grama, sand dropseed, and silver bluestem. Woody plants are mesquite, lotebush, and pricklypear. Sufficient cover for wildlife is not always available on this site. Food is in good supply during some periods but is limited during dry seasons.

The principal mammals on this site are rabbit, coyote, skunk, and oppossum. The principal birds are dove, quail, duck, and songbirds.

WILDLIFE SITE 4

This site consists of soils in the Woodward-Quinlan and Ector-LaCasa soil associations. The soils are mainly very shallow to deep. Most areas in this site have only a sparse cover of grasses. Nearly all of this site is in range. Grasses are mainly side-oats grama, blue grama, little bluestem, buffalograss, and black grama. Woody plants are principally redberry juniper, mesquite, and lotebush. The rough terrain and woody vegetation provide excellent cover for wildlife in most places, but food is sometimes scarce.

The principal mammals on this site are deer, coyote, bobcat, rabbit, oppossum, skunk, and racoon. The principal birds are quail, dove, duck, geese, and songbirds.

Engineering Uses of the Soils [4]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, facilities for water storage, erosion control structures, drainage systems, irrigation systems, and sewage disposal systems. Among the properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and reaction. Depth to water table and bedrock, the topography, and the hydrologic characteristics are also important.

The interpretations given in this section will be helpful to readers who are interested in the general characteristics of the soils. Engineers and those in related work will be interested in the tabular data.

The information in this survey can be used to:

1. Make preliminary estimates of the engineering properties of soils in the planning of terraces. farm ponds, irrigation systems, and other structures for the conservation of soil and water.
2. Make preliminary evaluations of soil and ground conditions that will aid in the selection of locations for highways, airports, and pipelines, and in planning detailed investigations of soils at the selected sites.
3. Locate probable sources of topsoil, sand, gravel, and other construction materials.
4. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
5. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
6. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
7. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Tables 3, 4, and 5 provide data useful in soils engineering. With the use of the soil map for identification, these interpretations can be useful for many purposes. It should be emphasized, however, that the engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. The estimated values for bearing capacity and traffic-supporting capacity expressed in words should not be assigned specific values. Estimates are generally made to a depth of about 5 feet, and interpretations do not apply to a greater depth. Included in the mapping are small areas of other soils that have contrasting characteristics and that may have different engineering properties than those listed. Even with these limitations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

Some terms used by soil scientists may be unfamiliar to engineers, and some words, such as gravel, sand, silt, and clay, have different meanings in soil science than they have in engineering. These and other terms are defined in the Glossary at the end of the survey.

Engineering classification systems

Agricultural scientists of the U.S. Department of Agriculture (USDA) classify soils according to texture, color, and structure (*7*). This system is useful only as the initial step in making engineering classifications of soils. The engineering properties of a soil must be determined or estimated after the initial classifications have been made. Two systems are used by engineers for classifying soils. These are the systems used by the American Association of State Highway Officials (AASHO) and the Unified system. These systems are explained briefly in the following paragraphs.

[4] Prepared by DAN C. HUCKABEE, civil engineer, Soil Conservation Service, Amarillo, Texas.

AASHO Classification System.—Most highway engineers classify soil material according to the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system soil material is classified in seven principal groups. The groups range from A–1, in which are gravelly soils of high bearing capacity, to A–7, which consists of clay soils having low strength when wet. Within each group, the relative load-carrying capacity of the soil material is indicated by a group index number. These numbers range from 0 for the best material to 20 for the poorest. The group index numbers are determined by the gradation, liquid limit, and plasticity index.

Unified Classification System.—Some engineers prefer to use the Unified Soil Classification System. In this system soil material is divided into 15 classes (*9*). Eight classes are for coarse-grained material (GW, GP, GM, GC, SW, SP, SM, and SC); six are for fine-grained material (ML, CL, OL, MH, CH, and OH); and one (Pt) is for highly organic material. Mechanical analyses are used to determine the GW, GP, SW, and SP classes of material; mechanical analyses and tests for liquid limit and plasticity index are used to determine GM, GC, SM, SC, and fine-grained soils. The soils of this county have been classified in the SP, SM, SC, ML, CL, and CH classes.

Estimated engineering properties

Table 3 gives the estimated engineering classification and some of the estimated properties of the soils. Some of the estimates were made on the basis of tests of 13 samples representing five soil series. The results of these tests are shown in table 5. For those soils not listed in table 5, estimates were obtained by comparing the soils not listed with the soils of similar series, were made on the basis of field tests, or were obtained from other soil surveys.

In the columns headed "Classification," some soils are given a range in the AASHO and Unified classifications because each soil has a defined range in properties. The columns headed "Percentage passing sieve—" show the percentage, or range in percentage, of soil material that is smaller in diameter than the openings in sieves of four different sizes.

Permeability, as shown in table 3, is the estimated rate, in inches per hour, that water moves through the soil. The estimates are for each soil as it occurs in place without compaction.

Available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. In table 3 it is expressed as inches of water per inch of soil.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value, and relative terms used to describe soil reaction, are explained in the glossary.

Shrink-swell potential indicates the change in volume that occurs in a soil with changes in moisture content. A knowledge of this potential is important in planning the use of a soil for building roads and other engineering structures. Shrink-swell potential is rated *low*, *moderate*, *high*, and *very high*. In general, deep clay loam soils have a high shrink-swell potential. Clean sands and gravel and those soils have small amounts of nonplastic to slightly plastic fines, as well as most other nonplastic to slightly plastic soil materials, have a low shrink-swell potential.

Soils are placed in one of four hydrologic groups on the basis of intake of water at the end of a long-duration storm, after prior wetting and opportunity for swelling and without the protection of vegetation. The groups range from open sands (lowest runoff potential, Group A) to heavy clays (highest runoff potential, Group D). Group A consists of soils that have high infiltration rates even when thoroughly wetted; they are chiefly deep, well-drained to excessively drained sands and gravel. These soils have a high rate of water transmission, and this results in a low runoff potential. Group B consists of soils that have moderate infiltration rates when thoroughly wetted; they are chiefly moderately deep to deep, moderately well drained to well drained soils of moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission. Group C consists of soils having slow infiltration rates when thoroughly wetted; they are chiefly (1) soils with a layer that impedes the downward movement of water or (2) soils with moderately fine texture to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission. Group D consists of soils having very slow infiltration rates when thoroughly wetted; they are chiefly (1) clay soils with a high swelling potential, (2) soils with a high permanent water table, (3) soils with a claypan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

Depth to bedrock is not given in table 3, because most soils in the county are underlain by bedrock at depths greater than 60 inches. The following soils have bedrock at a depth of less than 60 inches: Cottonwood soils, 8 inches (chalky gypsite); Ector soils, 7 inches (fractured limestone); Quinlan soils, 14 inches (weathered sandstone); and Woodward soils, 27 inches (weakly cemented sandstone). Depth to seasonal high water table is many feet in most of the soils. Consequently, depth to water table is not shown in the table. Lincoln soils have a seasonal water table at a depth of 4 to 20 feet.

Engineering interpretations

In table 4 the soils are rated according to their suitability as sources of topsoil and of road subgrade, and the properties that affect the suitability of the soils as sites for specified engineering uses are listed. The data in table 4 were estimated on the basis of the test data in table 5, the properties listed in table 3, and observations of the field performance of the soils.

Topsoil is fertile soil material that ordinarily is rich in organic matter. It is used to topdress areas where vegetation is to be established and maintained. Such areas are roadbanks, dams, disturbed areas, gardens, and lawns. Normally, only the surface layer is removed for topsoil, but other layers also may be suitable sources.

Road subgrade refers to soil material useful for building up road grades for supporting base layers. The suitability of a soil for road subgrade depends largely on its texture, plasticity, shrink-swell potential, traffic-supporting capacity, inherent erodibility, compaction characteristics, and natural water content. Soils with high shrink-swell potential are difficult to place and compact. They are rated poor as a source of road subgrade.

TABLE 3.—*Estimated*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that appear in the first column of this table. Properties of Blown-out land in Sn,

Soil series and map symbols	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Inches			
Abilene: AbA, AbB.	0–9	Clay loam	CL	A–6
	9–36	Silty clay loam	CL	A–7
	36–60	Clay loam	CL	A–6
Altus: Mapped only in an undifferentiated unit with Miles soils.	0–20	Fine sandy loam	SM	A–2, A–4
	20–48	Sandy clay loam	CL, SC	A–4
	48–64	Very fine sandy loam	CL, ML	A–4
*Brownfield: Bn. For Nobscot part, see the Nobscot series.	0–24	Fine sand	SM	A–2
	24–62	Sandy clay loam	SC	A–6
	62–66	Sandy loam	SM	A–2
Carey: CaA, CaB, CaC.	0–10	Loam	ML–CL	A–4
	10–20	Sandy clay loam	ML–CL, CL	A–6, A–4
	20–90	Very fine sandy loam	ML, ML–CL, SM	A–4, A–6
Colorado: Co.	0–60	Loam	ML–CL	A–4
Cottonwood. Mapped only in a complex with Lutie and Quinlan soils.	0–8	Loam	ML–CL	A–4
	8–18	Chalky gypsite.		
*Ector: El. For LaCasa part, see the LaCasa series.	0–7	Gravelly loam	GC, SC	A–2
	7–20	Fractured, platy, dolomitic limestone.		
Enterprise: EnB, EnC, EnD.	0–52	Very fine sandy loam	ML, ML–CL	A–4
LaCasa: LcB, LcC.	0–14	Silty clay loam	CL	A–6
	14–72	Clay loam	CL	A–6
Lincoln: Ls.	0–16	Loamy fine sand	SM	A–2
	16–50	Fine sand	SP–SM	A–3
*Lutie: LuB, LuC, Lx. For the Cottonwood and Quinlan parts of Lx, see the respective series.	0–6	Clay loam	CL, ML–CL	A–6
	6–60	Silty clay loam	CL, ML	A–4, A–6, A–7
*Mansker: MaB, MaC, MaD, Md. For Woodward part of Md, see Woodward series.	0–12	Fine sandy loam	SM	A–4
	12–30	Loam	ML	A–4
	30–60	Sandy loam	SM	A–2
*Miles:				
MeA, MfB, MfC, MfC2. For Altus part of MeA, see the Altus series.	0–10	Fine sandy loam	SM, SM–SC	A–2, A–4
	10–48	Sandy clay loam	SC, CL	A–4
	48–65	Fine sandy loam	SM	A–2, A–4
MlB, MlC, Ms3.	0–14	Loamy fine sand	SM	A–2, A–4
	14–64	Sandy clay loam	SC	A–4, A–6, A–2
	64–90	Sandy clay loam	SM, SM–SC	A–2, A–4
Nobscot. Mapped only in an undifferentiated unit with Brownfield soils.	0–31	Fine sand	SM, SP	A–2
	31–46	Fine sandy loam	SM, SC	A–2
	46–72	Loamy sand	SM	A–2
*Quinlan: Qw. For Woodward part, see the Woodward series.	0–5	Loam	ML, ML–CL	A–4
	5–14	Very fine sandy loam	ML, ML–CL	A–4
	14–30	Weathered sandstone.		

engineering properties

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions
Breaks in Wy, and Rough broken land in Rw are too variable to be estimated]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential	Hydrologic group
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	*Inches per hour*	*Inches per inch of soil*	*pH*		
100	100	95–99	75–95	0. 63–2. 0	0. 15–0. 19	6. 6–7. 3	Moderate.	C
100	100	95–99	90–95	0. 2–0. 63	0. 14–0. 18	6. 6–8. 4	Moderate.	
100	100	90–98	75–92	0. 2–0. 63	0. 12–0. 16	7. 9–8. 4	Moderate.	
100	100	90–100	30–50	0. 63–2. 0	0. 09–0. 14	6. 6–7. 3	Low.	B
100	100	90–100	40–60	0. 63–2. 0	0. 12–0. 16	6. 6–8. 4	Low.	
100	100	90–100	50–60	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Low.	
100	100	95–100	9–15	6. 3–20. 0	0. 05–0. 09	6. 1–6. 5	Low	A
100	100	95–100	36–45	0. 63–2. 0	0. 14–0. 16	6. 6–7. 3	Low.	
100	100	95–100	25–35	0. 63–2. 0	0. 14–0. 16	6. 6–7. 3	Low.	
100	100	85–95	60–80	0. 63–2. 0	0. 16–0. 18	7. 4–7. 8	Low.	B
100	100	80–90	60–80	0. 63–2. 0	0. 14–0. 18	7. 4–7. 8	Low.	
85–100	85–100	85–95	40–75	0. 63–2. 0	0. 14–0. 18	7. 4–8. 4	Low.	
100	100	85–95	60–75	0. 63–2. 0	0. 14–0. 18	7. 9–8. 4	Low.	B
100	100	85–95	65–75	0. 63–2. 0	0. 11–0. 14	7. 9–8. 4	Low.	C
30–70	20–65	15–50	12–35	0. 63–2. 0	0. 05–0. 10	7. 9–8. 4	Low.	C
100	100	95–99	80–90	2. 0–6. 3	0. 18–0. 20	7. 9–8. 4	Low.	B
100	100	95–100	85–95	0. 20–0. 63	0. 15–0. 18	7. 9–8. 4	Low.	C
100	100	90–100	85–90	0. 20–0. 63	0. 15–0. 18	7. 9–8. 4	Low.	
100	100	30–90	15–30	6. 3–20. 0	0. 05–0. 09	7. 9–8. 4	Low.	A
100	100	50–90	5–10	6. 3–20. 0	0. 05–0. 09	7. 9–8. 4	Low.	
95–100	95–100	95–99	85–90	0. 63–2. 0	0. 14–0. 17	7. 9–8. 4	Low.	B
90–100	87–100	85–100	70–95	0. 63–2. 0	0. 15–0. 18	7. 9–8. 4	Low.	
95–100	95–100	80–95	40–50	0. 63–2. 0	0. 11–0. 15	7. 4–8. 4	Low.	B
95–100	90–100	85–95	60–70	0. 63–2. 0	0. 13–0. 17	7. 9–8. 4	Low.	
90–100	85–100	90–98	30–35	0. 63–2. 0	0. 13–0. 17	7. 9–8. 4	Low.	
95–100	90–100	70–85	25–40	2. 0–6. 3	0. 11–0. 15	6. 6–7. 3	Low.	B
95–100	95–100	80–90	40–55	0. 63–2. 0	0. 11–0. 17	6. 6–7. 3	Low.	
90–100	80–100	70–85	25–40	0. 20–6. 3	0. 12–0. 16	6. 6–8. 4	Low.	
90–100	90–100	90–95	25–40	2. 0–6. 3	0. 07–0. 11	6. 6–7. 3	Low.	B
90–100	90–100	80–90	28–50	0. 63–2. 0	0. 13–0. 17	6. 6–7. 3	Low.	
90–100	90–100	80–90	28–40	0. 63–2. 0	0. 12–0. 16	7. 4–8. 4	Low.	
100	100	50–90	5–20	6. 3–20. 0	0. 05–0. 09	5. 6–6. 5	Low.	A
100	100	90–100	14–35	2. 0–6. 3	0. 07–0. 11	5. 6–6. 0	Low.	
100	100	50–90	14–30	2. 0–6. 3	0. 05–0. 09	6. 6–7. 3	Low.	
100	100	85–95	60–75	2. 0–6. 3	0. 13–0. 15	7. 9–8. 4	Low.	C
100	100	85–95	50–65	2. 0–6. 3	0. 13–0. 15	7. 9–8. 4	Low.	

TABLE 3.—*Estimated*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
*Springer: SfC, SfD.	0–32	Fine sandy loam	SM	A–4
	32–60	Loamy fine sand	SM	A–2
SgB, SgD, Sn. For Brownfield part of Sn, see the Brownfield series.	0–18	Loamy fine sand	SM	A–2
	18–30	Fine sandy loam	SM	A–2, A–4
	30–60	Loamy fine sand	SM	A–2
*Spur: Sp, Sr. For Colorado part of Sr, see the Colorado series.	0–60	Clay loam	CL, ML–CL	A–6
Tivoli: Tv.	0–60	Fine sand	SP–SM	A–3, A–2
*Wichita: WcA, WcB, WlA, WlC, WlC2. For Lutie part of WlA, WlC, and WlC2, see the Lutie series.	0–10	Loam	CL	A 6
	10–60	Clay loam	CL	A–6
*Woodward: WoB, WoC, WuC, Wy. For Quinlan part of WuC, see the Quinlan series; for Yahola part of Wy, see the Yahola series.	0–8	Loam	ML–CL, CL	A–4, A–6
	8–27	Very fine sandy loam	ML–CL, ML	A–4, A–6
	27–60	Sandstone.		
Yahola: Ya.	0–60	Fine sandy loam	SM, ML	A–4

TABLE 4.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first column of this table. Blown-out

Soil series and map symbols	Suitability as source of—		Degree of limitation and soil features affecting—		
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields
Abilene: AbA, AbB	Fair: clay loam texture.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair bearing capacity; moderate shrink-swell potential.	Severe: moderately slow permeability.
Altus. Mapped only in an undifferentiated unit with Miles soils.	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.
*Brownfield: Bn. For Nobscot part, see the Nobscot series.	Poor: fine sand texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight
Carey: CaA, CaB, CaC	Fair: 8 to 16 inches of loam material.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.

engineering properties—Continued

Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Shrink-swell potential	Hydrologic group
				Inches per hour	*Inches per inch of soil*	*pH*		
100	100	80–95	40–50	2. 0–6. 3	0. 11–0. 15	6. 6–7. 3	Low.	B
100	100	70–85	15–25	2. 0–6. 3	0. 05–0. 09	6. 6–7. 3	Low.	
90–100	90–100	70–85	25–35	2. 0–6. 3	0. 05–0. 09	6. 6–7. 3	Low.	B
95–100	90–100	80–95	25–40	2. 0–6. 3	0. 11–0. 14	6. 1–6. 5	Low.	
90–100	90–100	70–85	25–30	2. 0–6. 3	0. 06–0. 11	6. 1–7. 3	Low.	
100	100	95–100	70–85	0. 63–2. 0	0. 16–0. 18	7. 9–8. 4	Low.	B
100	100	65–80	5–12	6. 3–20. 0	0. 05–0. 08	6. 6–7. 3	Low.	A
95–100	80–100	90–100	60–75	0. 2–0. 63	0. 14–0. 16	6. 6–7. 3	Low.	C
98–100	95–100	85–100	80–90	0. 2–0. 63	0. 14–0. 18	6. 6–8. 4	Moderate.	
95–100	95–100	85–95	60–75	0. 63–2. 0	0. 14–0. 17	7. 9–8. 4	Low.	B
95–100	95–100	85–95	55–85	0. 63–2. 0	0. 14–0. 17	7. 9–8. 4	Low.	
100	100	70–85	40–55	2. 0–6. 3	0. 11–0. 15	7. 9–8. 4	Low.	B

properties

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions land in Sn; Breaks in Wy; and Rough broken land in Rw are too variable to be rated]

Degree of limitation and soil features affecting—Con.			Soil features affecting—			Corrosivity class and contributing soil features for—	
Sewage lagoons	Farm ponds: Reservoir areas	Farm ponds: Embankments	Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
Slight	Moderate: moderately slow permeability.	Moderate: medium compressibility.	Slow intake rate.	All features favorable.	All features favorable.	High: clay loam texture.	Low.
Moderate: moderate permeability.	Moderate: moderate permeability.	Slight	All features favorable.	All features favorable.	All features favorable.	Moderate: sandy loam texture.	Low.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	Rapid intake rate.	High susceptibility to soil blowing.	High susceptibility to soil blowing.	Moderate: sandy clay loam texture.	Low.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion; slope stability.	Slopes	All features favorable.	All features favorable.	Low	Low.

TABLE 4.—*Engineering*

Soil series and map symbols	Suitability as source of—		Degree of limitation and soil features affecting—		
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields
Colorado: Co	Good	Fair: fair traffic supporting capacity.	Moderate: fair bearing capacity; flood hazard.	Severe: hazard of flooding.	Severe: hazard of flooding.
Cottonwood. Mapped only in a complex with Lutie and Quinlan soils.	Poor: 3 to 10 inches of material.	Poor: 3 to 10 inches of material.	Severe: 3 to 10 inches to soft gypsite bedrock.	Severe: 3 to 10 inches to soft gypsite bedrock.	Severe: 3 to 10 inches to soft gypsite bedrock.
*Ector: El. For LaCasa part, see the LaCasa series.	Poor: more than 30 percent calcium carbonate equivalent.	Poor: 4 to 10 inches of material	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.
Enterprise: EnB, EnC, EnD	Good	Fair: fair traffic-supporting.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight where slopes are 0 to 5 percent; moderate where slopes are 5 to 10 percent; severe where slopes are over 10 percent.
LaCasa: LcB, LcC	Fair: silty clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.
Lincoln: Ls	Poor: loamy fine sand.	Good	Moderate: flood once in 5 to 20 years; severe: flood more than once in 5 years.	Severe: flood hazard.	Severe: flood hazard; inadequate filtration.
*Lutie: LuB, LuC, Lx. For the Cottonwood and Quinlan parts of Lx, see the respective series.	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.
*Mansker: MaB, MaC, MaD. Md. For Woodward part of Md, see the Woodward series.	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight where slopes are 0 to 5 percent; moderate where slopes are 5 to 10 percent; severe where slopes are over 10 percent.

properties—Continued

Degree of limitation and soil features affecting—Con.			Soil features affecting—			Corrosivity class and contributing soil features for—	
Sewage lagoons	Farm ponds		Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
	Reservoir areas	Embankments					
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium compressibility; fair resistance to piping and erosion.	Hazard of flooding.	Hazard of flooding.	Hazard of flooding.	Low	Low.
Severe: 3 to 10 inches to permeable bedrock.	Severe: 3 to 10 inches to permeable bedrock.	Severe: 3 to 10 inches of material.	3 to 10 inches to gypsite.	3 to 10 inches to gypsite.	3 to 10 inches to gypsite.	High conductivity.	Low.
Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches to bedrock.	Severe: 4 to 10 inches of material.	Nonarable	Nonarable	Nonarable	High conductivity.	Low.
Severe: moderately rapid permeability; slope over 7 percent in some places.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Slopes	Some steep slopes.	Steep slopes; erodible.	Low	Low.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium compressibility.	All features favorable.	All features favorable.	All features favorable.	Moderate: clay loam texture.	Low.
Severe: rapid permeability.	Severe: rapid permeability.	Severe: poor resistance to piping and erosion.	High water table; slight to strong salinity.	Severe hazard of soil blowing; texture.	Highly erodible.	High conductivity.	Moderate: sodium salts.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: fair slope stability.	Slopes	All features favorable.	All features favorable.	Moderate: silty clay loam texture.	Low.
Moderate: moderate permeability; severe slopes over 7 percent in some places.	Moderate: moderate permeability.	Moderate: medium compressibility.	10 to 20 inches to caliche.	Some steep slopes.	Some steep slopes.	Moderate: conductivity.	Low.

TABLE 4.—*Engineering*

Soil series and map symbols	Suitability as source of—		Degree of limitation and soil features affecting—		
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields
*Miles:					
MeA, MfB, MfC, MfC2. For the Altus part of MeA, see the Altus series.	Fair: 6 to 20 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight.
MIB, MIC, Ms3.	Poor: loamy fine sand texture.	Good.	Slight.	Slight.	Slight.
Nobscot. Mapped only in a complex with Brownfield soils.	Poor: fine sand texture.	Good.	Slight.	Slight.	Slight.
*Quinlan: Qw. For Woodward part, see the Woodward series.	Fair: 10 to 20 inches of material.	Poor: 10 to 20 inches of suitable material.	Severe: 10 to 20 inches to weathered sandstone.	Severe: 10 to 20 inches to weathered sandstone.	Severe: 10 to 20 inches to weathered sandstone.
Springer:					
SfC, SfD.	Good.	Good.	Slight where slopes are 0 to 6 percent; moderate where slopes are 6 to 8 percent.	Slight where slopes are 0 to 6 percent; moderate where slopes are 6 to 8 percent.	Slight where slopes are 0 to 5 percent; moderate where slopes are 5 to 8 percent.
*SgB, SgD, Sn. For Brownfield part of Sn, see the Brownfield series.	Poor: loamy fine sand texture.	Good.	Slight where slopes are 0 to 6 percent; moderate where slopes are 6 to 8 percent.	Slight where slopes are 0 to 6 percent; moderate where slopes are 6 to 8 percent.	Slight.
*Spur: Sp, Sr. For Colorado part of Sr, see the Colorado series.	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity; hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.
Tivoli: Tv.	Poor: fine sand texture.	Good.	Moderate: slopes.	Moderate: slopes.	Severe: inadequate filtration.
*Wichita: WcA, WcB, WIA, WIC, WIC2. For the Lutic part of WIA, WIC, and WiC2, see the Lutic series.	Fair: 7 to 15 inches of loam.	Fair: moderate shrink-swell potential; fair traffic-supporting capacity.	Moderate: moderate shrink-swell potential; fair traffic-supporting capacity.	Moderate: moderate shrink-swell potential; fair bearing capacity.	Severe: moderately slow permeability.

properties—Continued

Degree of limitation and soil features affecting—Con.			Soil features affecting—			Corrosivity class and contributing soil features for—	
Sewage lagoons	Farm ponds		Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
	Reservoir areas	Embankments					
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium compressibility; fair stability.	Slopes	All features favorable.	All features favorable.	Moderate: sandy clay loam texture.	Low.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: fair stability.	Rapid intake rate.	Moderate hazard of soil blowing.	Moderate hazard of soil blowing.	Moderate sandy clay loam texture.	Low.
Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Rapid intake rate.	Severe hazard of soil blowing; undulating topography.	Severe hazard of soil blowing.	Low	Low.
Severe: 10 to 20 inches to weathered sandstone.	Severe: 10 to 20 inches to weathered sandstone.	Severe: 10 to 20 inches to weathered sandstone.	Nonarable	Nonarable	Nonarable	Low	Low.
Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Moderately rapid intake rate.	Moderate hazard of soil blowing.	Moderate hazard of soil blowing.	Low	Low.
Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Rapid intake rate.	Severe hazard of soil blowing; undulating and hummocky topography.	Severe hazard of soil blowing.	Low	Low.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium compressibility.	Hazard of flooding.	Hazard of flooding.	Hazard of flooding.	Moderate: clay loam texture.	Low.
Severe: rapid permeability.	Severe: rapid permeability.	Severe: poor resistance to piping and erosion; poor stability.	High intake rate, low available water capacity; dune topography.	Dune topography; severe hazard of soil blowing.	Severe hazard of soil blowing.	Low	Low.
Slight where slopes are 0 to 2 percent; moderate where slopes are 2 to 6 percent.	Moderate: moderately slow permeability.	Moderate: medium compressibility.	Slow intake rate.	All features favorable.	All features favorable.	High: clay loam texture.	Low.

TABLE 4.—*Engineering*

Soil series and map symbols	Suitability as source of—		Degree of limitation and soil features affecting—		
	Topsoil	Road subgrade	Highway location	Foundations for low buildinrgs	Septic tank filter fields
*Woodward: WoB, WoC, WuC, Wy. For Quinlan part of WuC, see the Quinlan series; for Yahola part of Wy, see the Yahola series.	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity; severe where slopes are over 15 percent.	Moderate where slopes are 6 to 15 percent; fair bearing capacity; bedrock deeper than 40 inches; severe where slopes are over 15 percent.	Moderate where slopes are 5 to 10 percent; moderate permeability; severe where slopes over 10 percent.
Yahola: Ya	Good	Good	Moderate: hazard of flooding.	Severe: hazard of flooding.	Moderate: hazard of flooding.

TABLE 5.—*Engineering*

[Tests performed by Texas Highway Department in accordance with standard

Soil name and location	Parent material	Texas report No.	Depth from surface	Shrinkage limit	Lineal shrinkage	Shrinkage ratio
			Inches			
Carey loam:						
2,460 feet W. and 620 feet N. of SE. corner of sec. 85, Block 14. (Modal)	Sandy Permian red beds.	63-112-R 63-113-R	10-20 46-90	17 20	7. 5 2. 2	1. 76 1. 60
1,200 feet W. and 100 feet S. of NE. corner of sec. 58, Block 14. (More clayey C horizon than modal profile)	Sandy Permian red beds.	63-114-R 63-115-R	18-29 54-82	14 14	8. 9 9. 1	1. 88 1. 90
1,056 feet N. and 660 feet E. of SW. corner of sec. 85, Block 14. (Shallower Cca horizon than the modal profile)	Sandy Permian red beds.	63-116-R 63-117-R	12-30 30-60	14 15	5. 9 6. 4	1. 88 1. 87
Lutie clay loam:						
1.4 miles W. of Lutie and 50 feet S. of dirt road in sec. 4, Block 16. (Modal)	Silty Permian red beds.	63-128-R 63-129-R	4-14 14-24	20 22	6. 4 4. 9	1. 72 1. 64
1,000 feet N. and 200 feet E. of SW. corner of sec. 80, Block 11. (More clay and less calcium carbonate in the B3ca horizon than the modal profile)	Silty Permian red beds.	63-130-R 63-131-R	8-13 13-54	14 13	12. 0 13. 6	1. 91 1. 96
1,600 feet W. of NE. corner of sec. 33, Block 16. (No concretions of calcium carbonate in the A horizon)	Silty Permian red beds.	63-132-R 63-133-R	6-24 24-53	16 20	8. 7 5. 5	1. 84 1. 72
Miles loamy fine sand:						
0.6 mile S. and 600 feet W. of NE. corner of sec. 94, Block 10. (Modal)	Outwash material.	63-120-R 63-121-R	15-26 50-84	16 15	6. 1 3. 7	1. 81 1. 82

properties—Continued

Degree of limitation and soil features affecting—Con.			Soil features affecting—			Corrosivity class and contributing soil features for—	
Sewage lagoons	Farm ponds: Reservoir areas	Farm ponds: Embankments	Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
Moderate where slopes are 2 to 7 percent: permeability; severe where slopes are over 7 percent.	Moderate: moderate permeability.	Moderate: medium compressibility; poor resistance to piping and erosion.	All features favorable.	All features favorable.	All features favorable.	Low	Low.
Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: fair stability; poor resistance to piping and erosion.	Hazard of flooding.	Hazard of flooding.	Hazard of flooding.	Low	Low.

test data

procedures of the American Association of State Highway Officials (AASHO)(*1*)]

Mechanical analysis [1]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—						
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.			AASHO [2]	Unified [3]
							Percent			
100	100	97	72	50	23	19	32	17	A-6(10)	CL
99	99	98	44	20	5	3	25	3	A-4(2)	SM
100	100	96	72	57	28	24	31	17	A-6(10)	CL
86	85	83	62	48	24	20	32	18	A-6(9)	CL
100	100	97	63	49	20	17	25	9	A-4(6)	CL
98	98	95	62	56	22	16	27	11	A-6(6)	CL
99	97	95	88	78	23	17	33	11	A-6(8)	ML-CL [4]
92	87	81	70	62	16	13	32	8	A-4(7)	ML-CL
99	97	92	86	74	33	26	38	21	A-6(12)	CL
99	98	91	87	78	38	30	41	24	A-7-6(14)	CL
99	99	98	90	76	31	24	33	15	A-6(10)	CL
100	100	99	92	79	21	14	30	8	A-4(8)	ML-CL
100	100	91	40	30	19	17	27	13	A-6(2)	SC
99	99	84	28	18	11	10	21	5	A-2-4(0)	SM-SC

TABLE 5.—*Engineering*

Soil name and location	Parent material	Texas report No.	Depth from surface	Shrinkage limit	Lineal shrinkage	Shrinkage ratio
Nobscot fine sand:			*Inches*			
2,050 feet W. and 800 feet S. of NE. corner of sec. 51, Block 15. (Modal)	Eeolian sands.	63-124-R 63-125-R	4-31 31 66	14 17	1. 3 1. 5	1. 83 1. 79
100 feet N. and 500 feet E. of SW. corner of sec. 69, Block 15. (More clayey in the B2t horizon than the modal profile)	Eeolian sands.	63-126-R 63-127-R	4-23 23 41	15 16	. 7 3. 3	1. 83 1. 81
2,000 feet N. and 100 feet W. of SE. corner of sec. 54, Block 15. (Thinner in the B2t horizon than the modal profile)	Eeolian sands.	63-137-R 63-138-R	8-30 60-72	16 17	3. 2 2. 0	1. 80 1. 72
Woodward loam:						
0.3 mile E. and 300 feet N. of SW. corner of sec. 85, Block 14. (Modal)	Sandy Permian red beds.	63-134-R	9-26	20	3. 7	1. 69
1,800 feet W. and 1,000 feet N. of SE. corner of sec. 79, Block 14. (More clayey in the B2 horizon)	Sandy Permian red beds.	63-135-R	7-20	16	8. 7	1. 86
200 feet S. and 600 feet W. of NE. corner of sec. 25, Block 10. (Thicker in the B2 horizon)	Sandy Permian red beds.	63-136-R	10-51	16	2. 5	1. 77

[1] Mechanical analyses according to the AASHO Designation T 88 (*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

Highway location requires consideration of those features and qualities of the soil that affect the over-all performance of the soil for highways. The entire soil profile is evaluated, based on an undisturbed soil without artificial drainage. It is assumed that the surface soil, because of its higher organic-matter content, will be removed in construction and used for topsoil.

Foundations for low buildings require consideration of those features and qualities of undisturbed soils that affect the suitability for supporting foundations of low buildings less than three stories high. The foundations of a building transmit the weight of the structure onto the natural undisturbed soils. It is the substratum of the soil that generally provides the base for foundations and therefore is the material which should be evaluated. The Unified Classification System was used for evaluating the soils in terms of their bearing capacity, shrink-swell potential, and shear strength.

Among the soil features affecting use of the soils for septic tank filter fields and sewage lagoon limitations are permeability, level of the ground water, hazard of flooding, slope, depth to rock or other impervious materials, and presence of creviced material that may cause pollution of water supplies.

The principal features affecting use of soils for reservoir areas is the seepage rate. Highly plastic soils have low seepage rates, whereas coarse-textured soils do not have any binding or sealing characteristics and have high seepage rates.

Farm pond embankments require consideration of those features and qualities of disturbed soils that affect their suitability for constructing embankments. Both the subsoil and substratum are evaluated where they are contrasting in character and have significant thickness for use as borrow. The primary features that affect suitability are stability, compaction characteristics, susceptibility to piping, shrink-swell potential, compacted permeability, compressibility, erosiveness, and gypsum content.

Irrigation depends largely on rate of water intake, available water capacity, depth of soil, slope, and flooding hazard.

Terraces and diversions are affected by land slope, depth to bedrock or other unfavorable material, and soil blowing. Diversion terraces may be damaged or destroyed by floodwaters and the water channel may fill with sand when soil blowing occurs.

Grassed waterways are affected by stability of soil material, steepness of slope, and difficulty of growing needed plants. In Collingsworth County, the development and establishment of grassed waterways generally are not problems.

Steel pipe should have a protective coating when placed in any soil in the county to retard corrosion. In table 4 corrosivity ratings are given for soils of the county for

test data—Continued

Mechanical analysis [1]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—					AASHO [2]	Unified [3]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.				
							Percent			
100	100	74	10	5	2	2	20	3	A-2-4(0)	SP-SM
100	100	77	14	10	7	5	19	2	A-2-4(0)	SM
100	100	73	9	5	2	2	20	3	A-2-4(0)	SP-SM
100	100	80	23	17	11	11	22	5	A-2-4(0)	SM-SC
100	100	81	9	5	2	2	22	4	A-2-4(0)	SP-SM
100	100	75	15	12	9	9	21	2	A-2-4(0)	SM
99	99	97	85	56	16	12	27	5	A-4(8)	ML-CL
97	96	90	74	58	32	25	33	19	A-6(11)	CL
98	98	96	57	36	15	13	21	3	A-4(4)	ML

[2] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction purposes, AASHO Designation M 145-49.
[3] Based on the Unified Soil Classification System (*9*).
[4] Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within 2 points from A-line are to be given a borderline classification. An example of a borderline classification is ML-CL.

steel (based on soil conditions at a depth of 4 feet) and concrete.

Most of the soils in the county are not suitable as sources of sand or gravel. Generally, the Lincoln soils and Tivoli soils are fair sources of sand. There are a few sources of gravel along the major streams.

Engineering test data

Table 5 gives the engineering test data for soil samples from 13 soil profiles of five different soil series in Collingsworth County. The tests were performed by the Texas State Highway Department Testing Laboratory in accordance with standard procedures of the American Association of State Highway Officials (AASHO). The test data for the soil samples indicate the engineering characteristics of the soil at the specific location given. At other locations in the county these same soils will probably have similar characteristics. The engineering classifications by both the AASHO system and the Unified system are also listed. The following are brief explanations of the headings in table 5.

As moisture leaves a soil, the soil decreases in volume in proportion to the loss in moisture until a point is reached where shrinkage stops even though additional moisture is removed. The moisture content at which shrinkage stops is called the shrinkage limit. The shrinkage limit of a soil is a general indication of the clay content; it decreases as the clay content increases. In sand that contains little or no clay, the shrinkage limit is close to the liquid limit and is considered insignificant. As a rule, the load-carrying capacity of a soil is at a maximum when its moisture content is at or below the shrinkage limit. Sand does not follow this rule, because if it is confined, its load-carrying capacity is uniform within a considerable range in moisture content.

Lineal shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the stipulated percentage to the shrinkage limit.

The shrinkage ratio is the volume change resulting from the drying of a soil material divided by the loss of moisture caused by drying. The ratio is expressed numerically. The volume change used in computing shrinkage ratio is the change in volume that takes place in a soil when it dries from a given moisture content to a point where no further shrinkage takes place.

In mechanical analysis the soil components are sorted by particle size. Sand and other granular material are retained on a No. 200 sieve, but finer particles pass through the openings. Clay is the fraction smaller than 0.002 millimeter in diameter. The material intermediate in size between that held on the No. 200 sieve and that having a diameter of 0.002 millimeter is mostly silt.

The tests for liquid limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Formation, Classification, and Morphology of the Soils

This section discusses the effects of the five major factors of soil formation on the soils in Collingsworth County and the processes involved in soil horizon differentiation. Also, the current system of classifying soils is discussed and the soils are placed in some of the categories of that system. Finally, the morphology of the soils is discussed briefly.

Formation of the Soils

Soil is the product of the interaction of the five major factors of soil formation. They are climate, living organisms (especially vegetation), parent material, relief, and time. If a factor such as climate or vegetation has differed between two areas, the kind of soil that forms also is different.

Climate

Collingsworth County has a cool-temperate, dry steppe type of climate with mild winters. The dominant influence of climate on soil formation in the county has been the amount and distribution of precipitation. The low rainfall has retarded soil formation but has been sufficient to allow the growth of a good grass cover. The limited rainfall seldom wets the soil below the area of living roots.

The wind has also affected soil formation in this county from the time it deposited silts and sands over the preexisting land surface in the Pleistocene epoch to the present, when it continues to shift sand, silt, and clay on exposed surfaces.

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. Gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and changes in structure and porosity are among the changes caused by living organisms.

Vegetation, dominantly tall and mid grasses, has affected soil formation in Collingsworth County more than other living organisms. The climax vegetation has contributed toward organic-matter accumulation and darkening of soils.

Parent material

Parent material is the unconsolidated mass from which soil is formed. It determines the limits of the chemical and mineralogical composition of the soil. In Collingsworth County soils have formed from material deposited in the Permian, Tertiary, and Quaternary geological periods (*6*).

Tertiary.—Tertiary deposits are found only in the northwest corner of the county and occupy about 7 percent of the county. The deposits extend west and north into adjoining counties.

Permian.—The Permian deposits are either exposed or near the surface in areas that make up about 40 percent of the county. Five formations of this period are represented in the county. They are Dog Creek Shale, Blaine Gypsum, Cloud Chief Gypsum, Whitehorse Sandstone, and Quartermaster (*3*).

Quaternary.—The Quaternary deposits in the county are loamy and sandy materials. The deposits are either exposed or near the surface in areas that make up about 53 percent of the county. Dune sand and wind- or water-deposited terraces comprise smaller areas along the streams.

Relief

Relief affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. Soils that have steep slopes absorb less moisture and normally have less well-developed profiles than soils on flats or in depressions.

Plant cover is thinner on many of the steep slopes. This increases the susceptibility to erosion and retards soil formation.

Soil temperature varies slightly with position of the slopes. North-facing slopes are slightly cooler in summer than south-facing slopes.

Time

Time, generally a long time, is required for the formation of soils having distinct horizons. The differences in length of time that parent materials have been in place are commonly reflected in the degree of development of the soil profile.

The soils in Collingsworth County range from young to old. The young soils have little profile development, and the older soils have well-expressed soil horizons.

Processes of Soil Horizon Differentiation

Several processes were involved in the formation of soil horizons in the soils of Collingsworth County. These processes are: (1) accumulation of organic matter; (2) leaching of calcium carbonate and bases; and (3) formation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the formation of horizons.

Accumulation of organic matter in the upper part of the profile to form an A1 horizon has been important. Generally, the soils of Collingsworth County are medium to high in organic-matter content. Organic-matter content is low in areas where the soils have been eroded.

Leaching of carbonates and bases has occurred in such soils as the Abilene, Carey, and Miles soils. Some leaching

has occurred in Wichita soils, which do not have free lime in the upper 15 to 20 inches. Some of the soils in the county are only slightly leached. LaCasa silty clay loam, for example, has a thick A horizon that is high in carbonates. Leaching is slow in the silty clay loam, and consequently there has not been enough time for removal of the carbonates.

In Abilene and Miles soils, there has been some translocation of clay minerals. This has contributed to horizon formation. The B horizons generally have accumulation of clay (clay films) in pores and on ped surfaces. These soils were probably leached of carbonates and soluble salts before the translocation of silicate clays took place.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, see their relationship to one another and to the whole environment, and understand their behavior and their response to manipulation. First through classification and then through use of the soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*5*). The current system of classification was adopted by the National Cooperative Soil Survey, effective March 1967. The system has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. The placement of some soil series in the current system, particularly in families, may change as more precise information becomes available. Readers interested in the development of the system should refer to the latest literature available (*4*), (*8*). Table 6 shows the classification of the soils in this county according to the family, subgroup, and order.

Morphology of the Soils

The marks that the soil-forming factors leave on the soil are recorded in the soil profile—a succession of layers, or horizons, from the surface down to rock. The horizons differ in one or more properties such as color, texture, structure, consistence, porosity, and reaction. They may be thick or thin.

Most soil profiles contain three major horizons called A, B, and C. In some young soils a B horizon has not developed.

The A horizon is the surface layer. The A1 is the horizon of maximum organic-matter accumulation. Where all or part of the A1 horizon has been disturbed by cultivation, it is called the Ap horizon.

The B horizon lies immediately beneath the A horizon and is called the subsoil. The B2t horizon is more dominant in Collingsworth County than the B2 horizon. The B2t horizon is a horizon of maximum accumulation of dissolved or suspended materials such as clay. The B2 horizon is a structural B horizon. Both the B2t and B2 horizons are generally firmer than horizons immediately above or below and may have subangular blocky or blocky structure.

Next is the C horizon. It is relatively little affected by the soil-forming process, but can be material modified by weathering. The C horizon generally is called the substratum or underlying material.

Climate [5]

Collingsworth County has a cool-temperate, dry steppe climate characterized by mild winters. The average annual rainfall during a 13-year period is 20.58 inches.

[5] By Robert B. Orton, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

TABLE 6.—*Classification of soil series*

Series	Family	Subgroup	Order
Abilene	Fine, mixed, thermic	Pachic Argiustolls	Mollisols.
Altus	Fine-loamy, mixed, thermic	Pachic Argiustolls	Mollisols.
Brownfield [1]	Loamy, mixed, thermic	Arenic Aridic Paleustalfs	Alfisols.
Carey	Fine-silty, mixed, thermic	Typic Argiustolls	Mollisols.
Colorado	Fine-loamy, mixed, calcareous, thermic	Typic Ustifluvents	Entisols.
Cottonwood	Loamy-carbonatic, thermic, shallow	Ustic Torriorthents	Entisols.
Ector [1]	Loamy-skeletal, carbonatic, thermic	Lithic Calciustolls	Mollisols.
Enterprise	Coarse-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
LaCasa	Fine, mixed, thermic	Typic Argiustolls	Mollisols.
Lincoln	Sandy, mixed, thermic	Typic Ustifluvents	Entisols.
Lutie [1]	Fine-silty, mixed, thermic	Calciorthidic Paleustolls	Mollisols.
Mansker [1]	Fine-loamy, mixed, thermic	Aridic Calciustolls	Mollisols.
Miles	Fine-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Nobscot	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols.
Quinlan	Loamy, mixed, thermic, shallow	Typic Ustochrepts	Inceptisols.
Springer	Coarse-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Spur	Fine-loamy, mixed, thermic	Fluventic Haplustolls	Mollisols.
Tivoli	Mixed, thermic	Typic Ustipsamments	Entisols.
Wichita	Fine, mixed, thermic	Typic Paleustalfs	Alfisols.
Woodward	Coarse-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
Yahola	Coarse-loamy, mixed, calcareous, thermic	Typic Ustifluvents	Entisols.

[1] The soils of Collingsworth County that are named for this series are in a more humid environment than is defined for this series.

Table 7 summarizes data on climate recorded at Wellington in Collingsworth County.

Over a long period, Collingsworth County is likely to receive a slightly greater total annual precipitation, on an average, than the counties on the High Plains to the west. The climate is marked by rapid changes in temperature and a wide range between extremes, both daily and annually.

Although the period for which rainfall data are available is short, it illustrates the extreme variability in monthly and annual totals. Total rainfall in the wettest year was approximately three times that of the driest year. Rains occur most frequently as the result of thunderstorms, and the maximum amount of rain falls late in spring and early in summer. A primary peak in rainfall occurs in May and June, and there is a secondary peak in October. Nearly three-fourths of the average annual rainfall occurs in the six-month period of May through October. Dry spells of several weeks to a month or more are not unusual.

In winter, frequent cold fronts from the north cut off moist air from the Gulf of Mexico, and the amount of precipitation received is rather limited. Wintertime precipitation falls as rain, freezing rain, snow, or sometimes mixed rain and snow. Snowfalls are generally light, and the snow remains on the ground only a short time. Average annual snowfall is about one-half to two-thirds that of counties on the High Plains immediately to the west.

Storms are most frequent late in spring and early in summer. Hail or strong winds may accompany almost any thunderstorm, but destructive storms are relatively infrequent and cover a small area. Winds are strongest during intense thunderstorms, but these are gusts.

Strong, continuous winds usually occur more frequently in March and April. Such winds are conducive to blowing of the soil and resultant duststorms. The prevailing winds are generally northerly from November through March and southerly from May through September. April and October are transitional months.

Temperature, like rainfall, shows extreme variability, especially during the colder six months of the year, November through April. Cold fronts from the northern Rocky Mountains and Plains sweep across the area at speeds of 20 to 40 miles per hour. Temperature drops of 40 to 50 degrees within a 12-hour period are not uncommon. Cold spells are generally of short duration. They rarely prevail more than 2 or 3 days before southwesterly winds cause rapid warming.

The average freeze-free season is 213 days, but the length of this period varies considerably from year to year. The average number of days between the last occurrence of 28° F. in spring and the first in fall is 230 days. The average date of the last occurrence of 32° in spring is April 4. On an average, 1 year in 5 a freeze occurs after April 15. The average date of the first occurrence of 32° in fall is November 3. On an average, 1 year in 5 a freeze occurs before October 22. Because of the differences in elevation and slope of the terrain, these average dates vary locally within the county, and commonly on the same farm.

Relative humidity averages about 76 percent at 6:00 a.m. and about 47 percent at noon. Sunshine is abundant the year round; the sun shines on an average of about 70 percent of the possible hours.

The average annual rate of lake evaporation is estimated at 66 inches. Of this amount, about 45 inches is evaporated in the period May through October.

In summary, the climate of Collingsworth County is slightly warmer, both in summer and in winter, than that of counties on the High Plains to the west. Rainfall, relative humidity, and the incident of severe local storms are also slightly higher.

TABLE 7.—*Precipitation at Wellington, Texas*

[Period of record, 1951 through 1963; elevation, 2,030 feet]

Month	Average monthly [1]	Greatest daily [1]	Year	Driest year [1] (1952)	Wettest year [1] (1960)	1 year in 10 will have—		Average number of days having precipitation of [2]—			Snow and sleet		
						Less than—	More than—	0.10 inch or more	6.50 inches or more	1.00 inch or more	Average monthly [3]	Maximum monthly [3]	Year
	In.	In.		In.	In.	In.	In.				In.	In.	
January	0.46	0.45	1960	0.95	1.23	0	1.2	1	0	0	1.5	11.0	1960
February	.56	.72	1961	.21	1.24	0	1.2	2	(4)	0	1.8	5.4	1963
March	1.06	1.44	1961	1.26	1.26	.1	3.0	3	1	(4)	.8	5.0	1958
April	1.92	2.30	1953	3.68	(5)	.2	5.0	3	1	1	0	0	------
May	4.31	4.00	1956	.72	4.39	.8	7.9	6	4	2	0	0	------
June	3.04	2.12	1960	.42	6.40	.3	7.3	6	3	2	0	0	------
July	1.97	4.83	1953	.72	1.73	.3	5.0	4	1	(4)	0	0	------
August	1.00	1.82	1954	.21	3.15	0	3.0	3	1	(4)	0	0	------
September	1.87	2.52	1962	.69	2.13	0	5.5	3	2	1	0	0	------
October	2.76	3.95	1960	0	8.93	0	8.8	4	2	1	0	0	------
November	.81	2.62	1961	.88	0	0	3.0	2	(4)	(4)	.4	4.0	1962
December	.82	2.32	1959	.95	2.65	0	3.7	2	1	(4)	1.8	14.3	1960
Year	20.58	4.83	1953	10.69	33.11	11.0	31.0	39	16	7	6.3	14.3	1960

[1] For a 13-year period.
[2] For a 10-year period.
[3] For an 11-year period.
[4] Less than one-half day.
[5] Trace.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or packing.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bedding plane. Horizontal contact plane or face between strata that were mainly deposited by water.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefingers, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Gypsite. An incoherent mass of small gypsum crystals having a soft, earthy appearance and containing impurities such as silica or clay.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Packsand. A massive, coherent layer or bed of geologic sand that is or has been under pressure.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Permian red bed. Geologic material of Permian age consisting of weakly cemented sandstones and shales having a reddish color.

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

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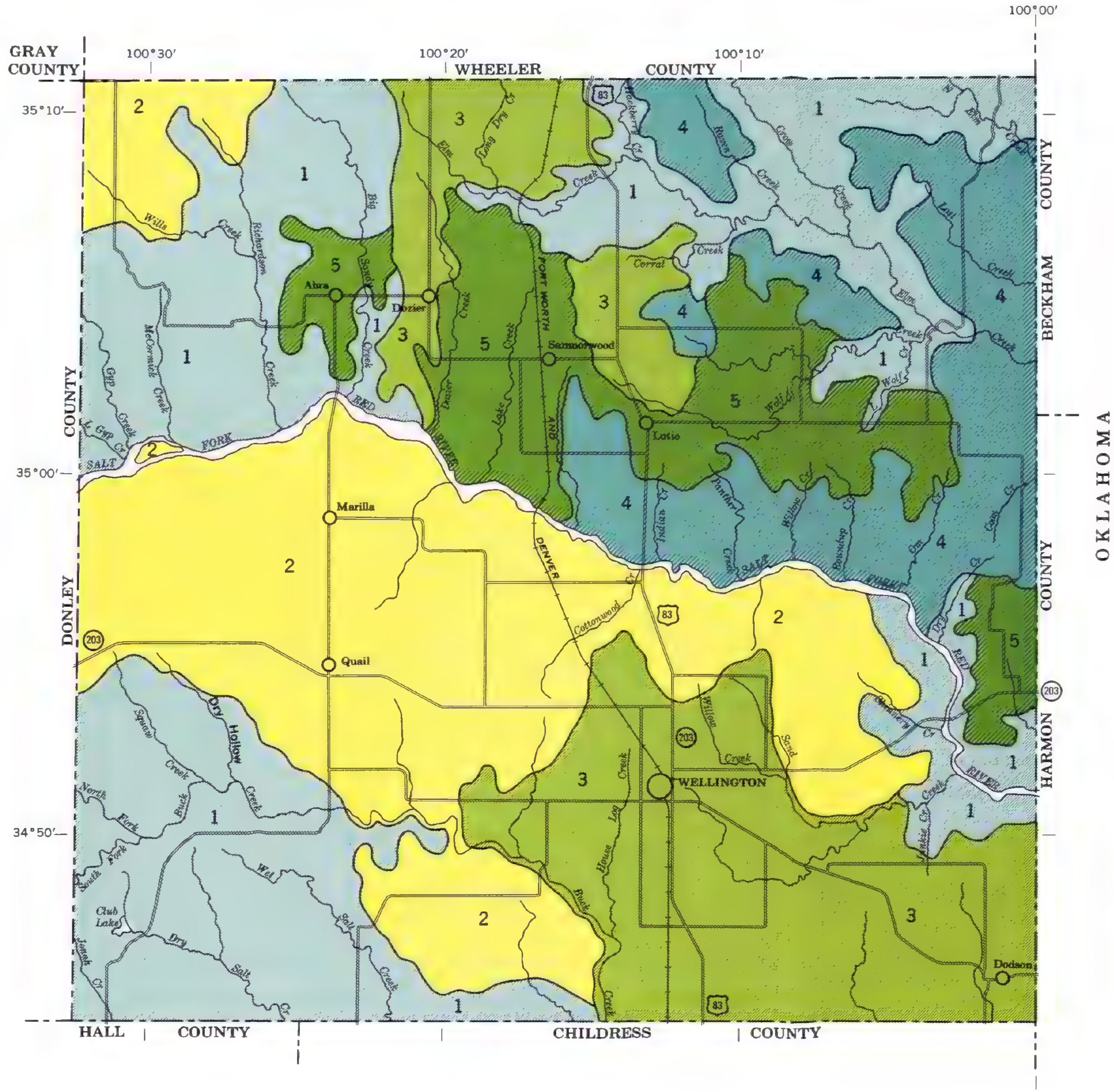


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

COLLINGSWORTH COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

N

SOIL ASSOCIATIONS *

1 Woodward-Quinlan association: Shallow to moderately deep, loamy soils over weakly cemented sandstone

2 Miles-Springer association: Deep, nearly level to sloping, sandy soils

3 Miles-Carey association: Deep, nearly level to gently sloping, loamy soils

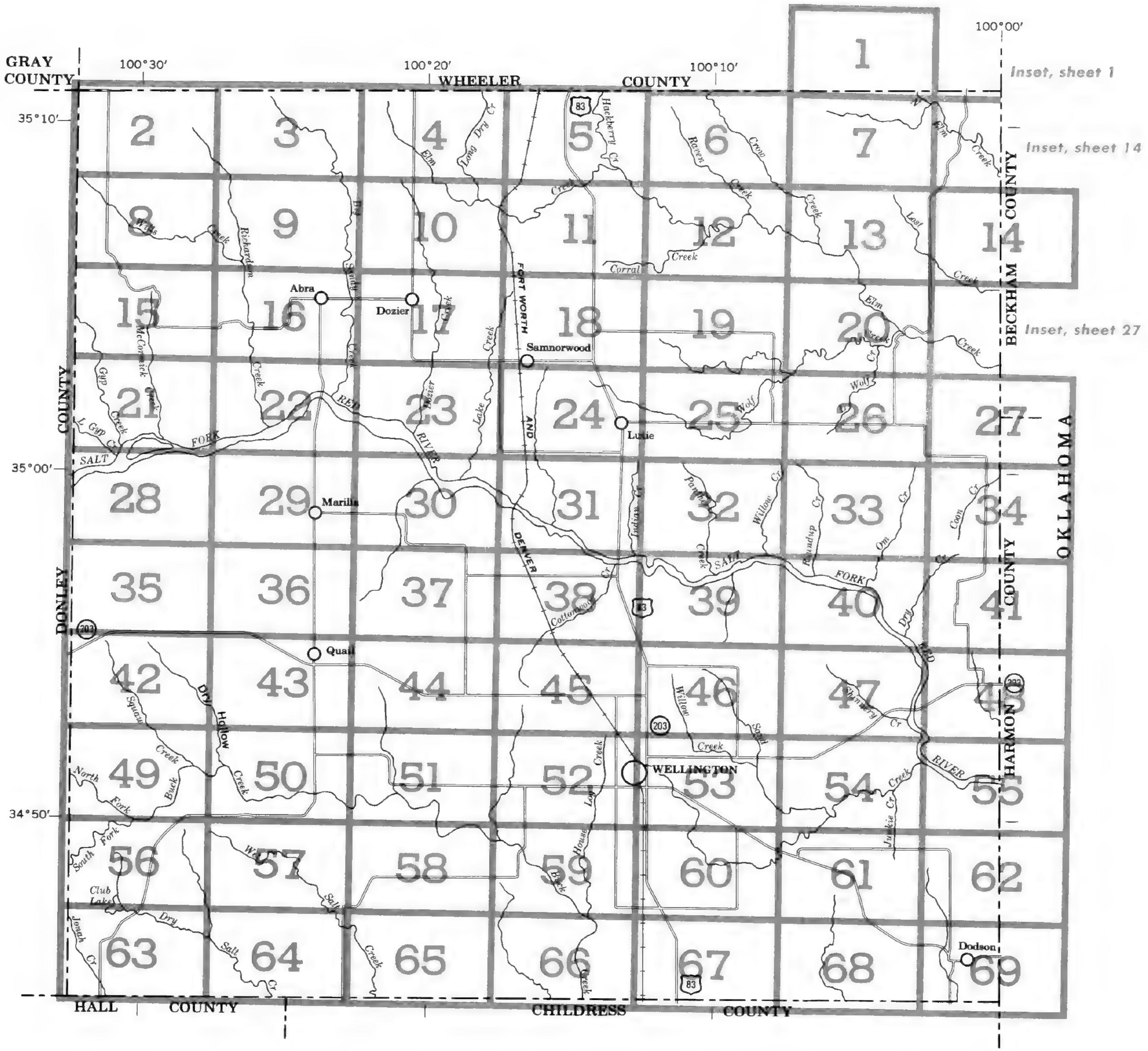
4 Ector-LaCasa association: Very shallow and deep, gently sloping to sloping, loamy soils

5 Wichita-Lutie association: Deep, nearly level to sloping, loamy soils

* Texture as used in this legend refers to the surface layer.

Compiled 1972

This map is for general planning. It shows only the major soils and does not contain sufficient detail for operational planning.



INDEX TO MAP SHEETS

COLLINGSWORTH COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

N

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, or D, shows the slope. Most symbols without a slope letter are for nearly level soils or land types, but some land types have a considerable range of slope. A final number, 2 or 3, in the symbol shows that the soil is eroded or severely eroded. (W) following the soil name indicates that signs of erosion, especially of local shifting of soil by wind, are evident in some places, but the degree of erosion cannot be estimated reliably.

SYMBOL	NAME
AbA	Abilene clay loam, 0 to 1 percent slopes
AbB	Abilene clay loam, 1 to 3 percent slopes
Bn	Brownfield-Nobscot fine sands (W)
CaA	Carey loam, 0 to 1 percent slopes
CaB	Carey loam, 1 to 3 percent slopes
CaC	Carey loam, 3 to 5 percent slopes
Co	Colorado loam
El	Ector-LaCasa complex
EnB	Enterprise very fine sandy loam, 1 to 3 percent slopes
EnC	Enterprise very fine sandy loam, 3 to 5 percent slopes
EnD	Enterprise very fine sandy loam, 5 to 12 percent slopes
LcB	LaCasa silty clay loam, 1 to 3 percent slopes
LcC	LaCasa silty clay loam, 3 to 5 percent slopes
Ls	Lincoln soils (W)
LuB	Lutie clay loam, 1 to 3 percent slopes
LuC	Lutie clay loam, 3 to 6 percent slopes
Lx	Lutie-Quinlan-Cottonwood complex
MaB	Mansker fine sandy loam, 1 to 3 percent slopes
MaC	Mansker fine sandy loam, 3 to 5 percent slopes
MaD	Mansker fine sandy loam, 5 to 8 percent slopes
Md	Mansker-Woodward complex
MeA	Miles and Altus soils, 0 to 1 percent slopes
MfB	Miles fine sandy loam, 1 to 3 percent slopes
MfC	Miles fine sandy loam, 3 to 5 percent slopes
MfC2	Miles fine sandy loam, 3 to 5 percent slopes, eroded
MlB	Miles loamy fine sand, 0 to 3 percent slopes (W)
MlC	Miles loamy fine sand, 3 to 5 percent slopes (W)
Ms3	Miles soils, severely eroded
Qw	Quinlan-Woodward loams
Rw	Rough broken land-Woodward complex
SfC	Springer fine sandy loam, 3 to 5 percent slopes (W)
SfD	Springer fine sandy loam, 5 to 8 percent slopes (W)
SgB	Springer loamy fine sand, undulating (W)
SgD	Springer loamy fine sand, hummocky (W)
Sn	Springer-Brownfield-Blown-out land complex
Sp	Spur clay loam
Sr	Spur and Colorado soils
Tv	Tivoli fine sand (W)
WcA	Wichita loam, 0 to 1 percent slopes
WcB	Wichita loam, 1 to 3 percent slopes
WlA	Wichita-Lutie loams, 0 to 2 percent slopes
WlC	Wichita-Lutie loams, 2 to 6 percent slopes
WlC2	Wichita-Lutie loams, 2 to 6 percent slopes, eroded
WoB	Woodward loam, 1 to 3 percent slopes
WoC	Woodward loam, 3 to 5 percent slopes
WuC	Woodward-Quinlan loams, 2 to 5 percent slopes
Wy	Woodward-Yahola-Breaks complex
Ya	Yahola fine sandy loam

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Well, irrigation — I.W.

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Unclassified

Canals and ditches

Lakes and ponds
- Perennial — water, w
- Intermittent — int

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which the mapping unit belongs. In referring to a capability unit or a range site, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, p. 7.
Estimated yields, table 2, p. 29.

Engineering uses of the soils, tables 3, 4, and 5, pp. 40 through 51.

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Name	Range site Page
AbA	Abilene clay loam, 0 to 1 percent slopes	8	IIce-4	26	Deep Hardland	33
AbB	Abilene clay loam, 1 to 3 percent slopes	8	IIIe-2	26	Deep Hardland	33
Bn	Brownfield-Nobscot fine sands	9	VIe-7	29	Deep Sand	33
CaA	Carey loam, 0 to 1 percent slopes	9	IIce-2	25	Mixedland	34
CaB	Carey loam, 1 to 3 percent slopes	9	IIe-1	26	Mixedland	34
CaC	Carey loam, 3 to 5 percent slopes	9	IIIe-3	26	Mixedland	34
Co	Colorado loam	10	IIce-3	26	Loamy Bottomland	31
El	Ector-LaCasa complex	11				
	Ector soil	--	VIIs-1	29	Very Shallow	36
	LaCasa soil	--	VIIs-1	29	Deep Hardland	33
EnB	Enterprise very fine sandy loam, 1 to 3 percent slopes	11	IIe-1	26	Mixedland	34
EnC	Enterprise very fine sandy loam, 3 to 5 percent slopes	11	IIIe-3	26	Mixedland	34
EnD	Enterprise very fine sandy loam, 5 to 12 percent slopes	11	VIe-4	28	Mixedland	34
LcB	LaCasa silty clay loam, 1 to 3 percent slopes	12	IIe-2	26	Deep Hardland	33
LcC	LaCasa silty clay loam, 3 to 5 percent slopes	12	IIIe-2	26	Deep Hardland	33
Ls	Lincoln soils	12	Vw-2	28	Sandy Bottomland	32
LuB	Lutie clay loam, 1 to 3 percent slopes	13	IIIe-7	27	Shallow Redland	35
LuC	Lutie clay loam, 3 to 6 percent slopes	13	IVe-2	27	Shallow Redland	35
Lx	Lutie-Quinlan-Cottonwood complex	13				
	Lutie soil	--	VIe-4	28	Shallow Redland	35
	Quinlan soil	--	VIe-4	28	Mixedland	34
	Cottonwood soil	--	VIe-4	28	Gypland	35
MaB	Mansker fine sandy loam, 1 to 3 percent slopes	14	IIIe-8	27	Sandy Loam	35
MaC	Mansker fine sandy loam, 3 to 5 percent slopes	14	IVe-5	28	Sandy Loam	35
MaD	Mansker fine sandy loam, 5 to 8 percent slopes	14	VIe-3	28	Sandy Loam	35
Md	Mansker-Woodward complex	14				
	Mansker soil	--	VIe-4	28	Sandy Loam	35
	Woodward soil	--	VIe-4	28	Mixedland	34
MeA	Miles and Altus soils, 0 to 1 percent slopes	15	IIIe-4	27	Sandy Loam	35
MfB	Miles fine sandy loam, 1 to 3 percent slopes	15	IIIe-4	27	Sandy Loam	35
MfC	Miles fine sandy loam, 3 to 5 percent slopes	15	IVe-4	27	Sandy Loam	35
MfC2	Miles fine sandy loam, 3 to 5 percent slopes, eroded	15	IVe-3	27	Sandy Loam	35
MlB	Miles loamy fine sand, 0 to 3 percent slopes	16	IVe-6	28	Sandyland	32
MlC	Miles loamy fine sand, 3 to 5 percent slopes	16	VIe-6	29	Sandyland	32
Ms3	Miles soils, severely eroded	16	VIe-6	29	Sandyland	32
Qw	Quinlan-Woodward loams	17	VIe-4	28	Mixedland	34
Rw	Rough broken land-Woodward complex	17				
	Rough broken land	--	VIIs-2	29	Rough Breaks	35
	Woodward soil	--	VIIs-2	29	Mixedland	34
SfC	Springer fine sandy loam, 3 to 5 percent slopes	18	IVe-9	28	Sandy Loam	35
SfD	Springer fine sandy loam, 5 to 8 percent slopes	19	VIe-5	28	Sandy Loam	35
SgB	Springer loamy fine sand, undulating	19	IVe-11	28	Sandyland	32
SgD	Springer loamy fine sand, hummocky	19	VIe-6	29	Sandyland	32
Sn	Springer-Brownfield-Blown-out land complex	19				
	Springer soil	--	VIe-7	29	Sandyland	32
	Brownfield soil	--	VIe-7	29	Deep Sand	33
	Blown-out land	--	VIe-7	29	Sandyland	32
Sp	Spur clay loam	20	IIce-1	25	Loamy Bottomland	31
Sr	Spur and Colorado soils	20	Vw-1	28	Loamy Bottomland	31
Tv	Tivoli fine sand	21	VIIe-1	29	Deep Sand	33
WcA	Wichita loam, 0 to 1 percent slopes	21	IIce-4	26	Deep Hardland	33
WcB	Wichita loam, 1 to 3 percent slopes	21	IIIe-2	26	Deep Hardland	33
WlA	Wichita-Lutie loams, 0 to 2 percent slopes	22				
	Wichita soil	--	IIIe-2	26	Deep Hardland	33
	Lutie soil	--	IIIe-2	26	Shallow Redland	35
WlC	Wichita-Lutie loams, 2 to 6 percent slopes	22				
	Wichita soil	--	IVe-2	27	Deep Hardland	33
	Lutie soil	--	IVe-2	27	Shallow Redland	35
WlC2	Wichita-Lutie loams, 2 to 6 percent slopes, eroded	23				
	Wichita soil	--	IVe-3	27	Deep Hardland	33
	Lutie soil	--	IVe-3	27	Shallow Redland	35
WoB	Woodward loam, 1 to 3 percent slopes	23	IIe-1	26	Mixedland	34
WoC	Woodward loam, 3 to 5 percent slopes	23	IIIe-3	26	Mixedland	34
WuC	Woodward-Quinlan loams, 2 to 5 percent slopes	23	IIIe-3	26	Mixedland	34
Wy	Woodward-Yahola-Breaks complex	24				
	Woodward soil	--	VIe-4	28	Mixedland	34
	Yahola soil	--	VIe-4	28	Loamy Bottomland	31
	Breaks	--	VIe-4	28	Rough Breaks	35
Ya	Yahola fine sandy loam	24	IIw-1	26	Loamy Bottomland	31

455-234 O-73 - (face map)

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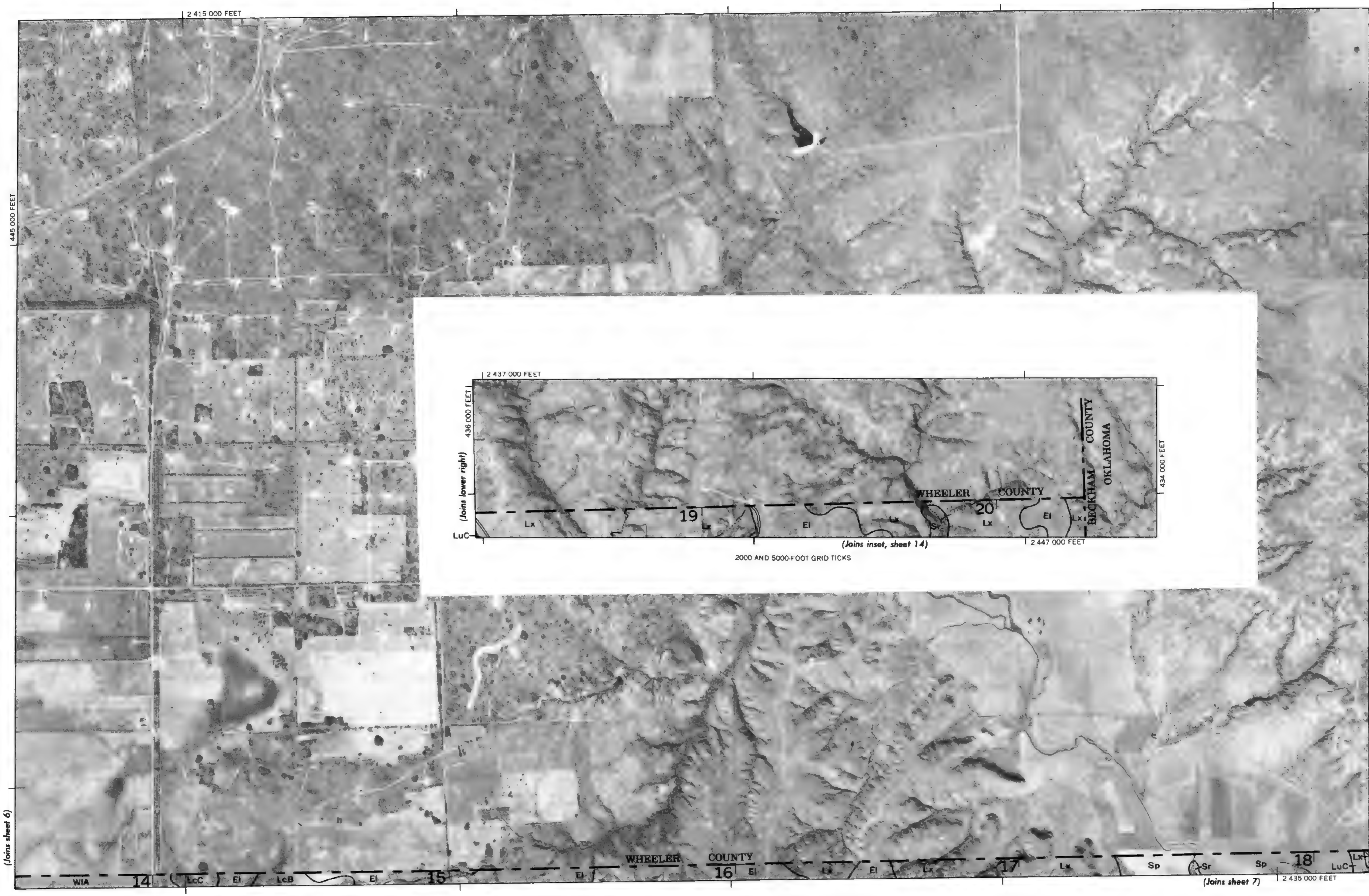
Land division corners are approximately positioned on this map.



1 ¾ ½ ¼ 0 1 Mile
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet
Scale 1:20 000

(2)

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 2

N

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

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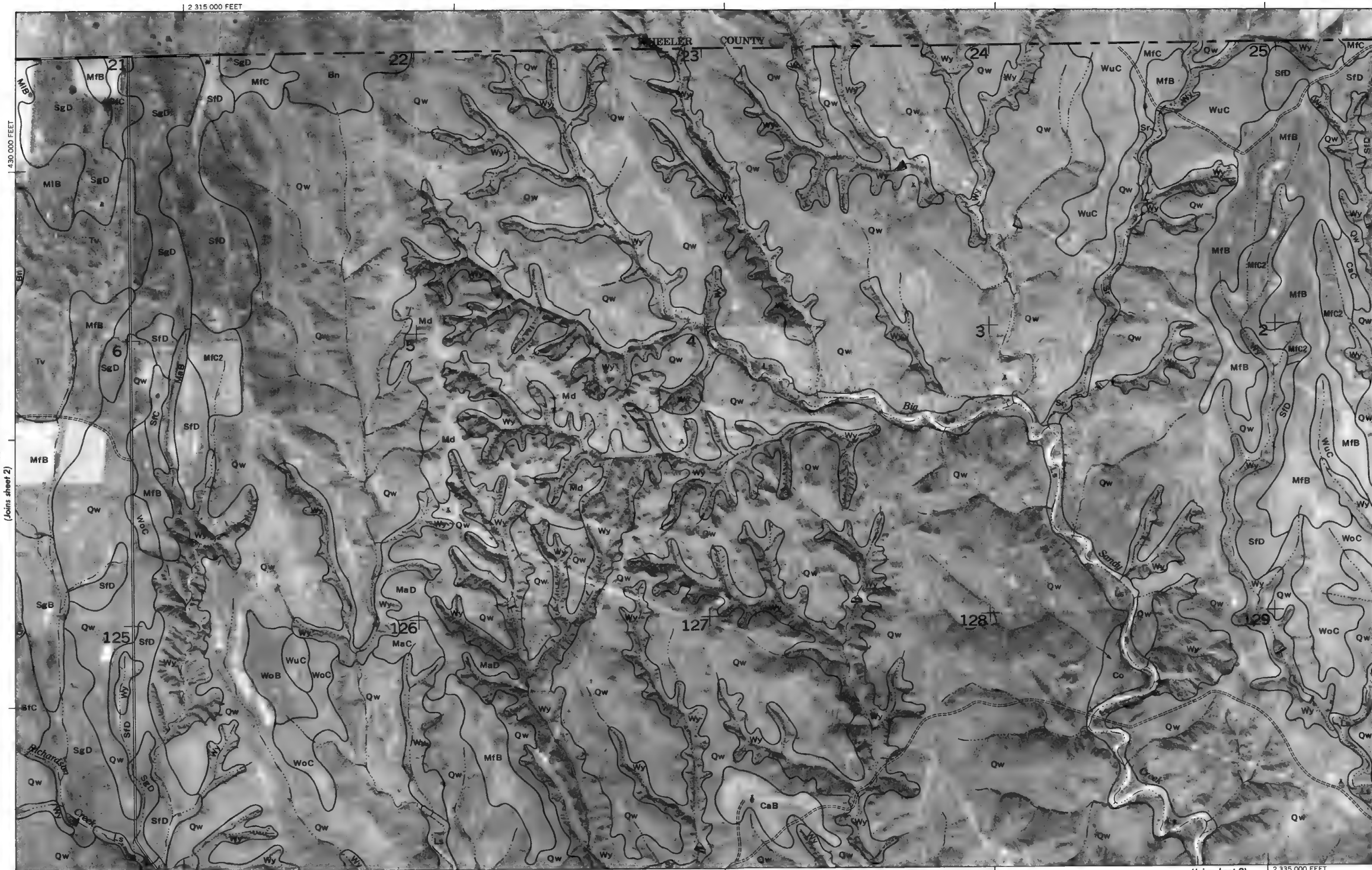


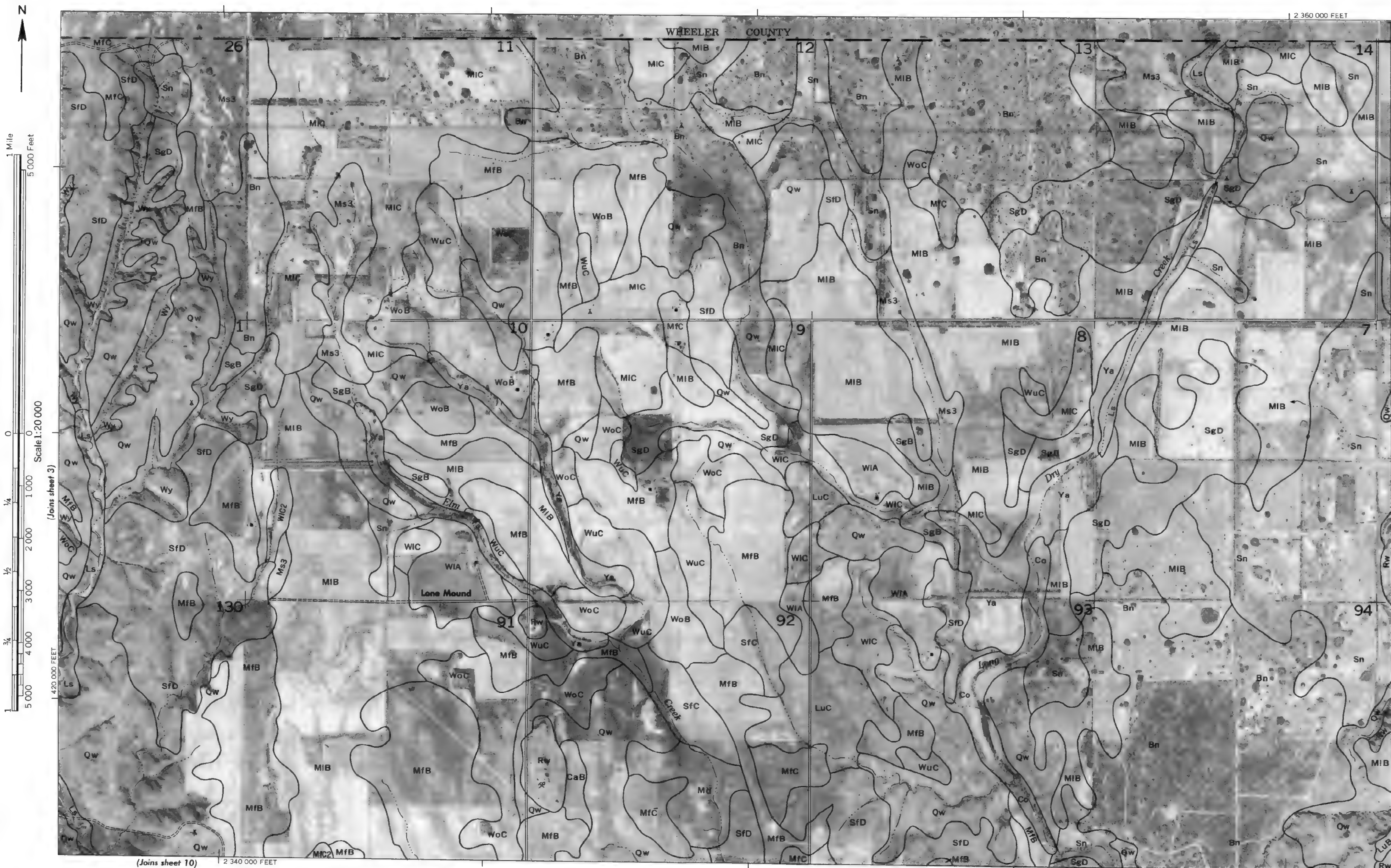
N

Scale 1:20 000

1 Mile
1/4
1/2
3/4
0
1

5 000 Feet
0
1000
2000
3000
4000
5000

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 4



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5

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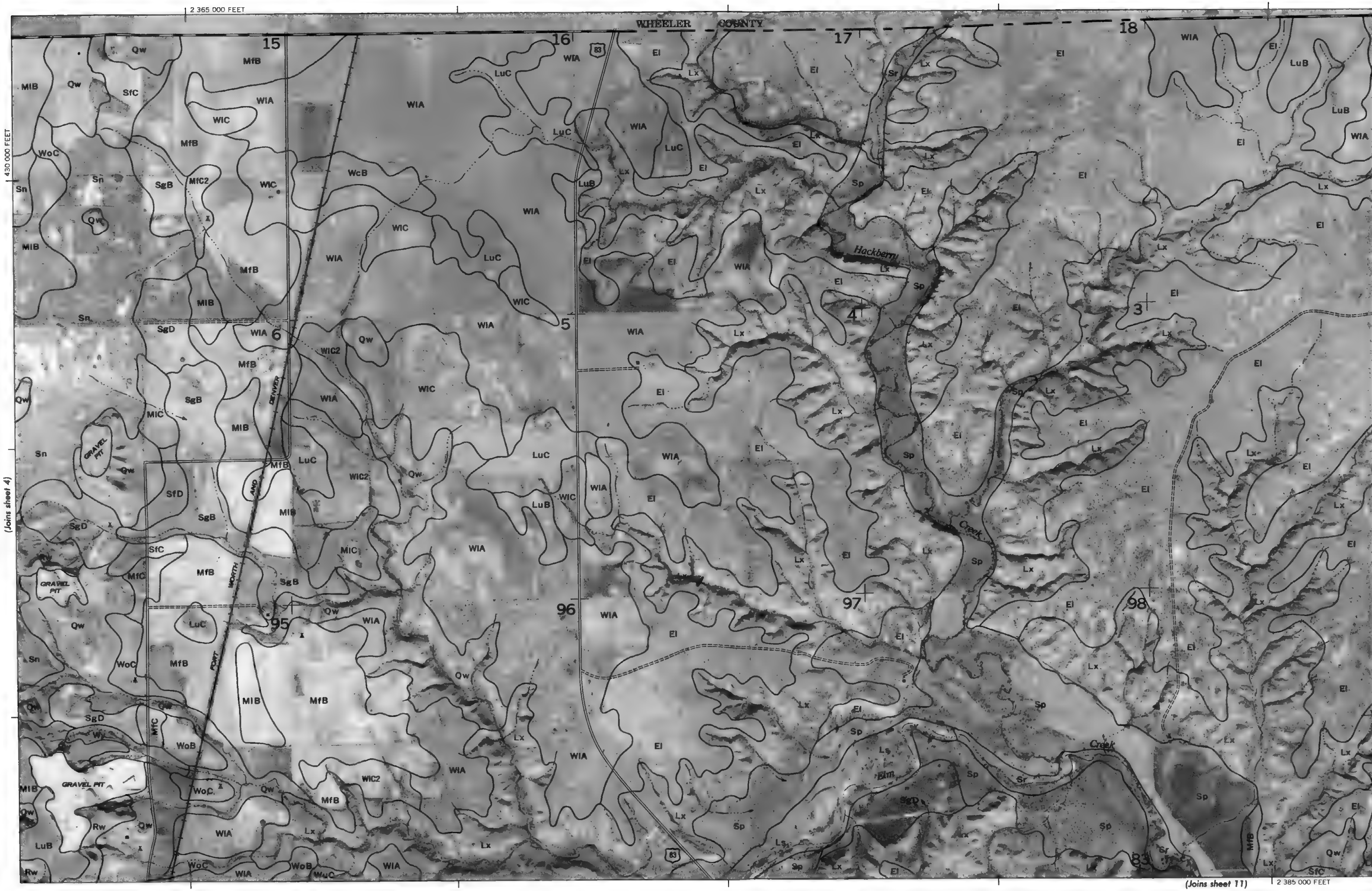


(Joins sheet 4)

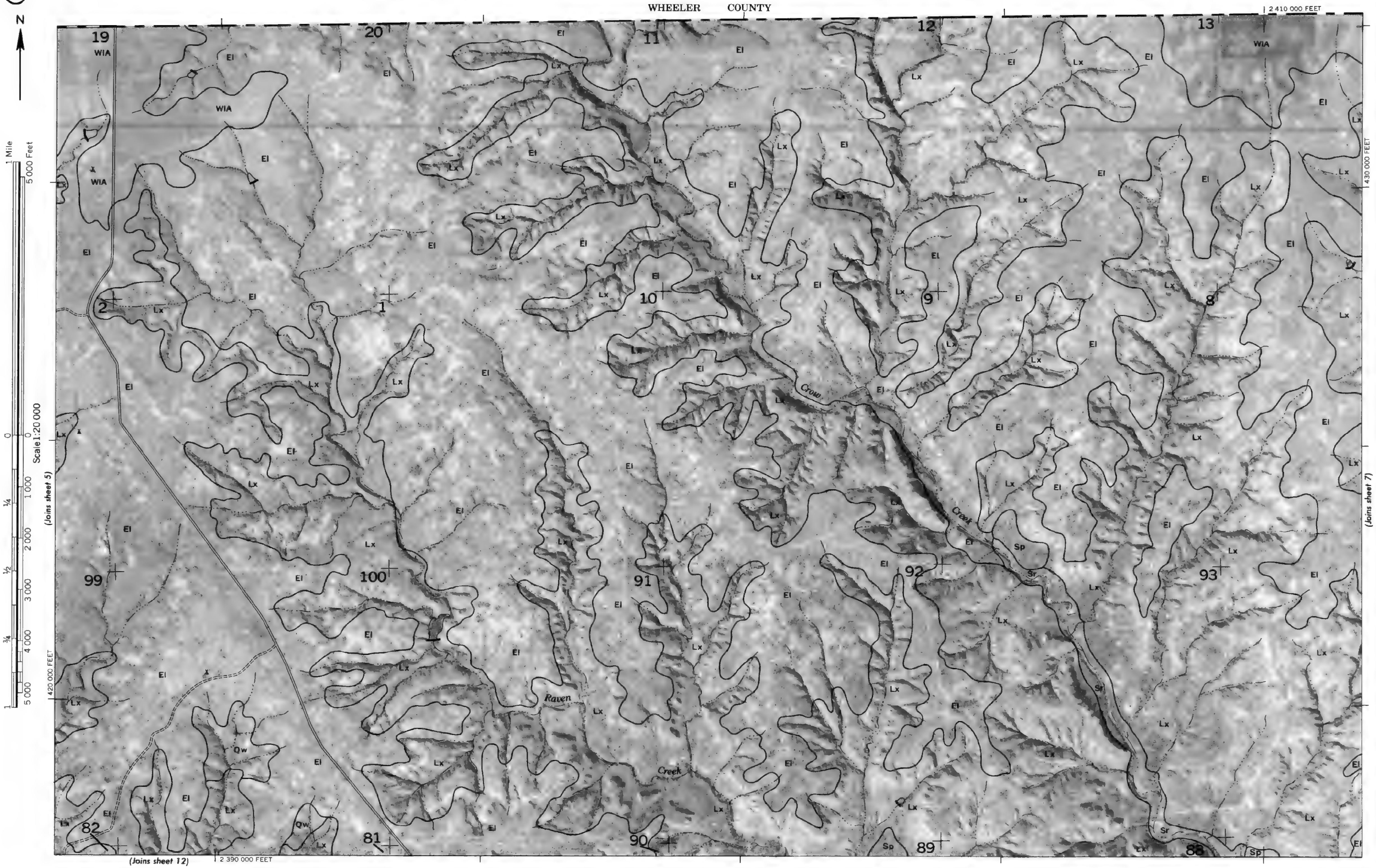
(Joins sheet 6)

N

1 Mile
5 000 Feet
Scale 1:20 000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

(Joins sheet 11)

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 6



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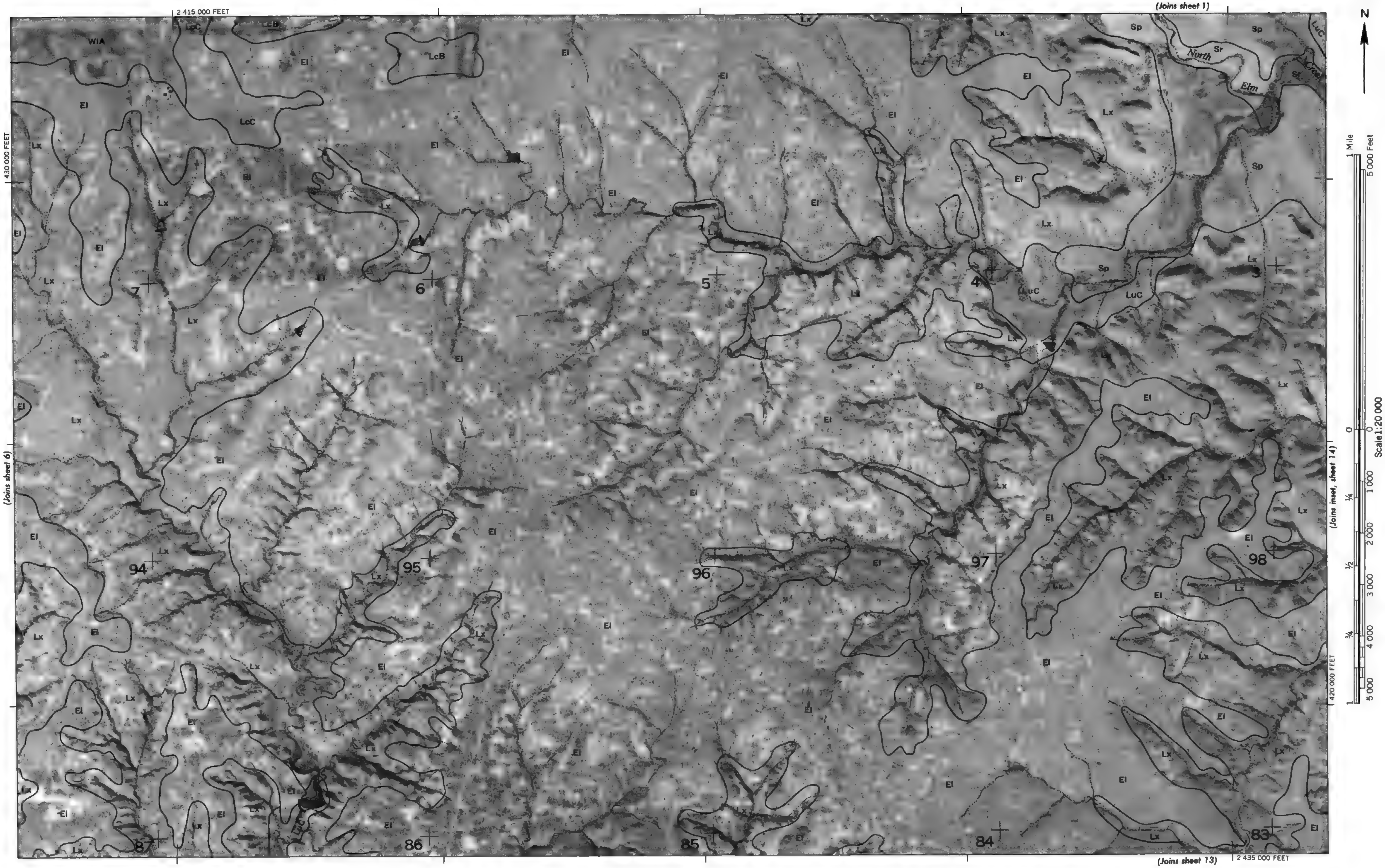
7



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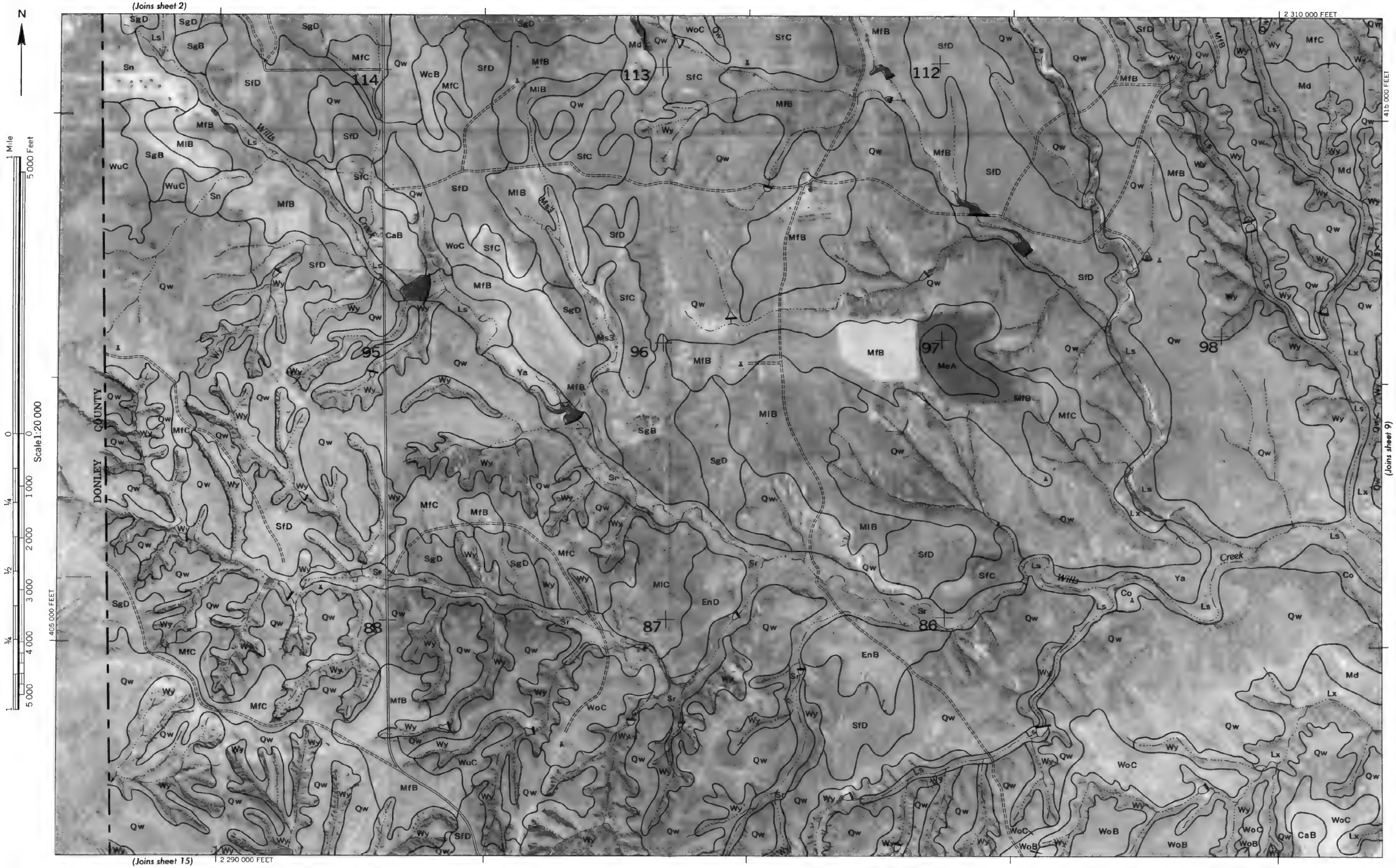
COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 8



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Land division corners are approximately positioned on this map.

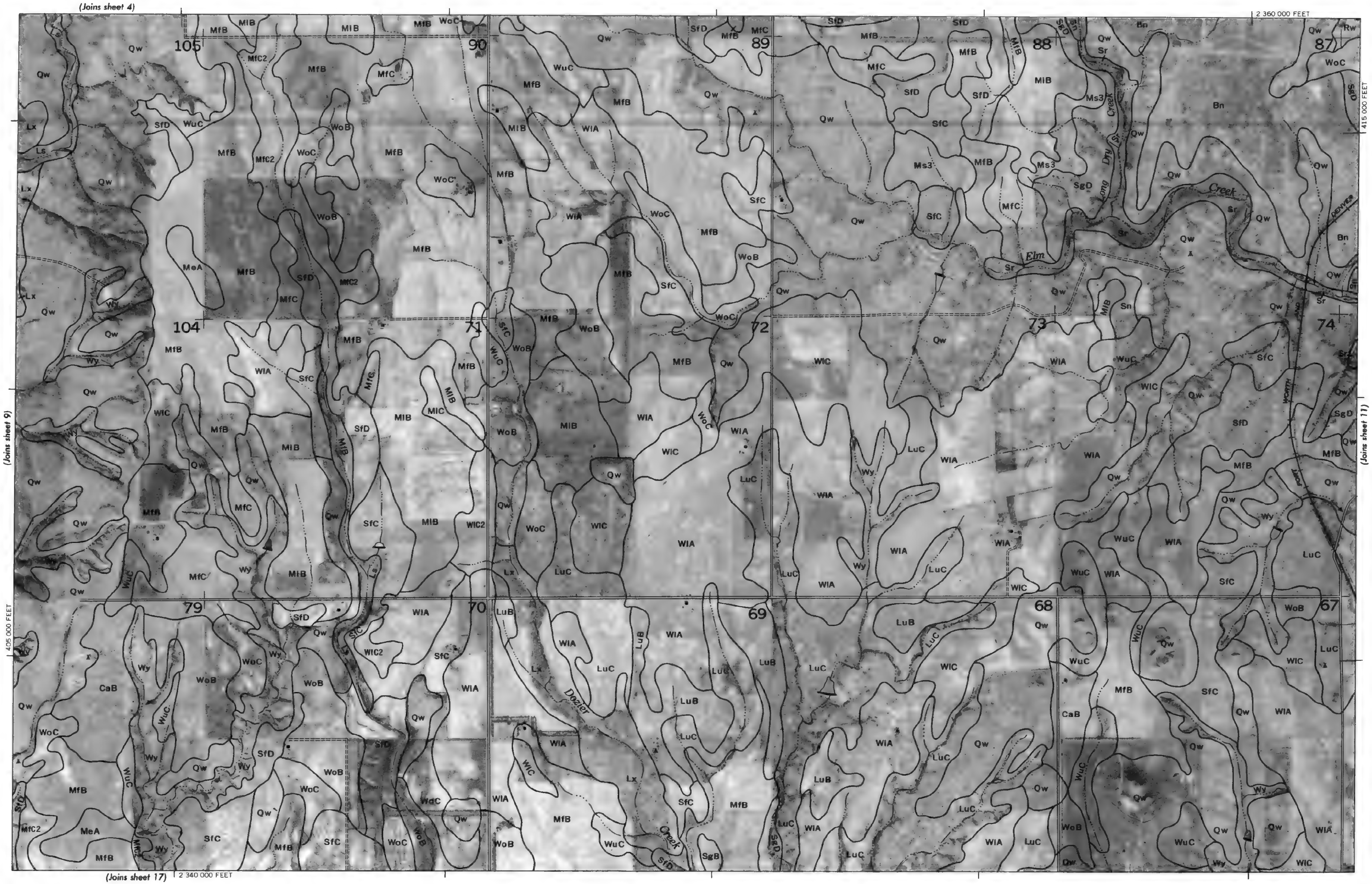
N

Scale 1:20 000

1 Mile · ¾ · ½ · ¼ · 0

5 000 Feet · 4 000 · 3 000 · 2 000 · 1 000 · 0

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 10



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Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

Scale 1:20 000

1 Mile | 5 000 Feet | 0 | 0 | ¼ | 1 000 | 2 000 | ½ | 3 000 | ¾ | 4 000 | 1 | 5 000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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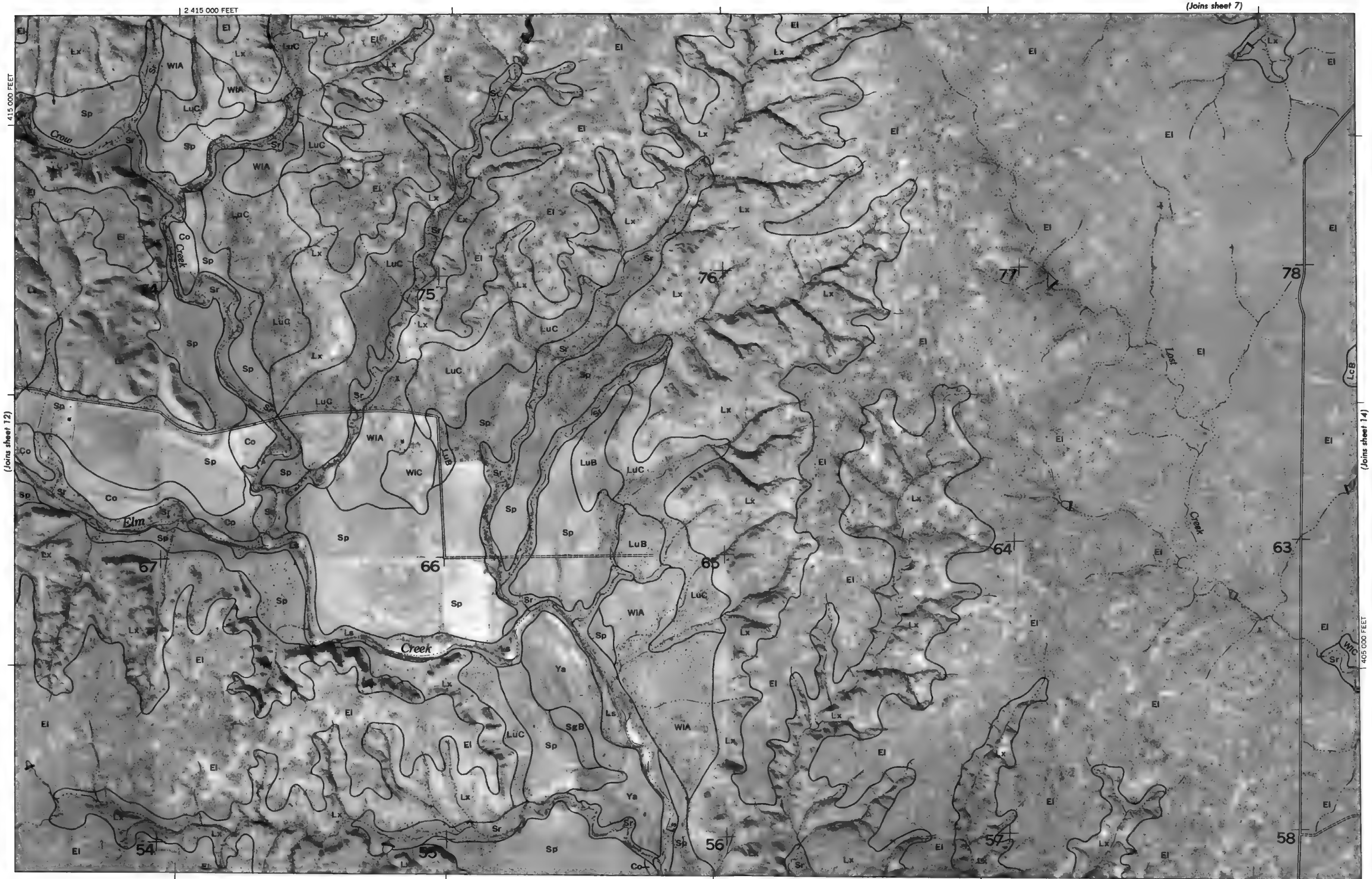
13

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.



N

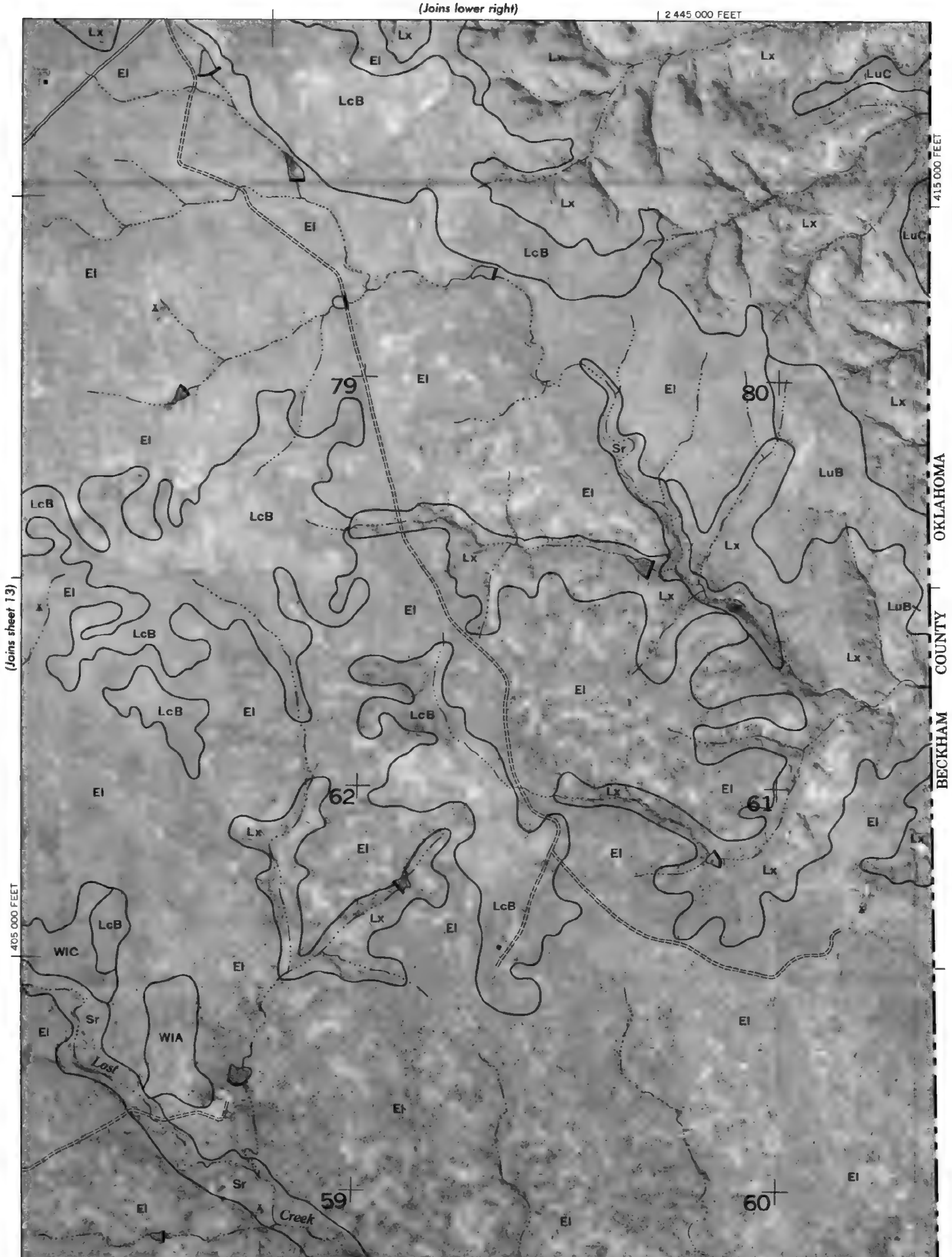
1 Mile
5 000 Feet
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
Scale 1:20 000

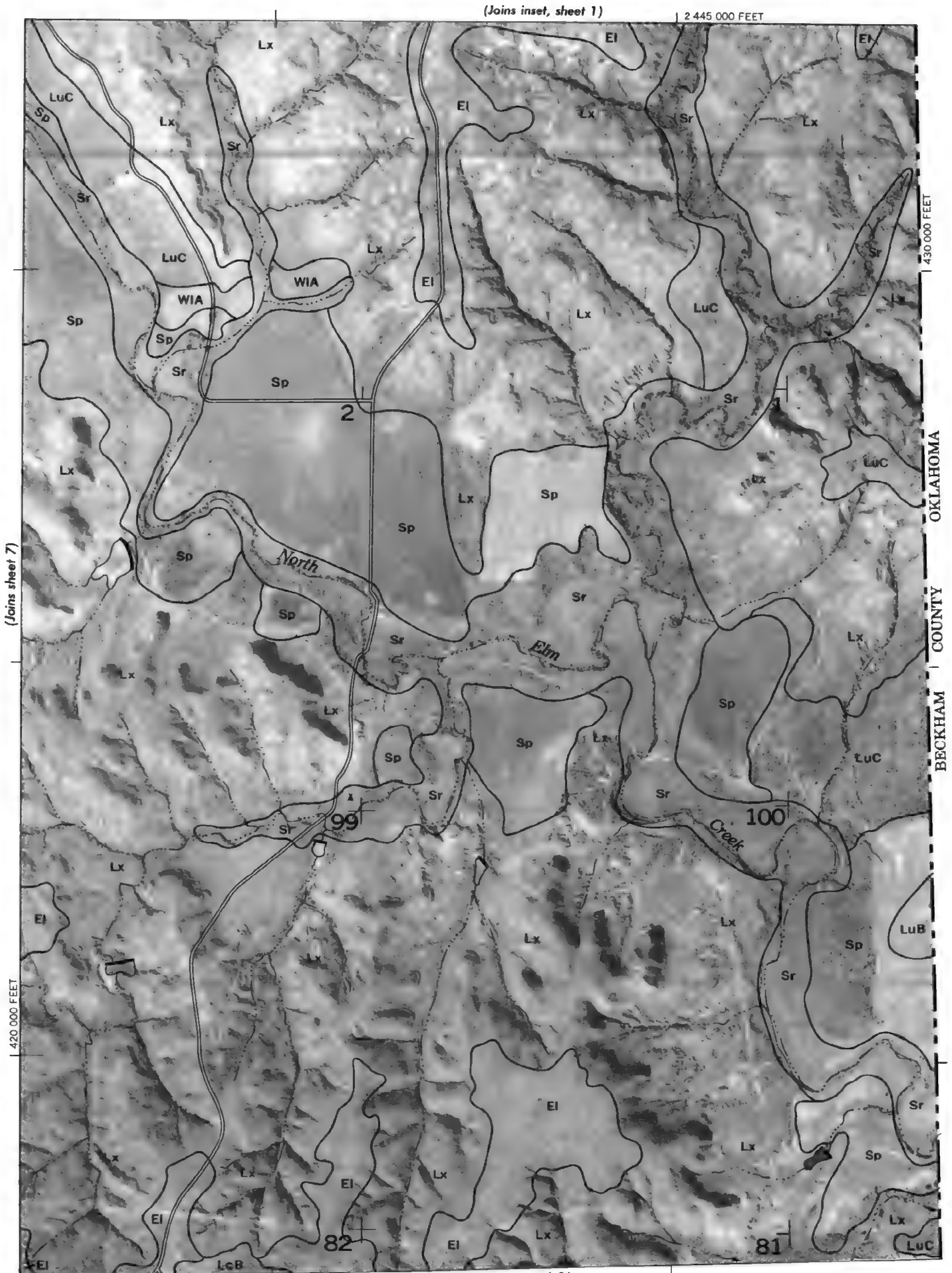
COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 14

N

Scale 1:20 000

1 Mile ½ ¼ 0 — 5 000 Feet 4 000 3 000 2 000 1 000 0





Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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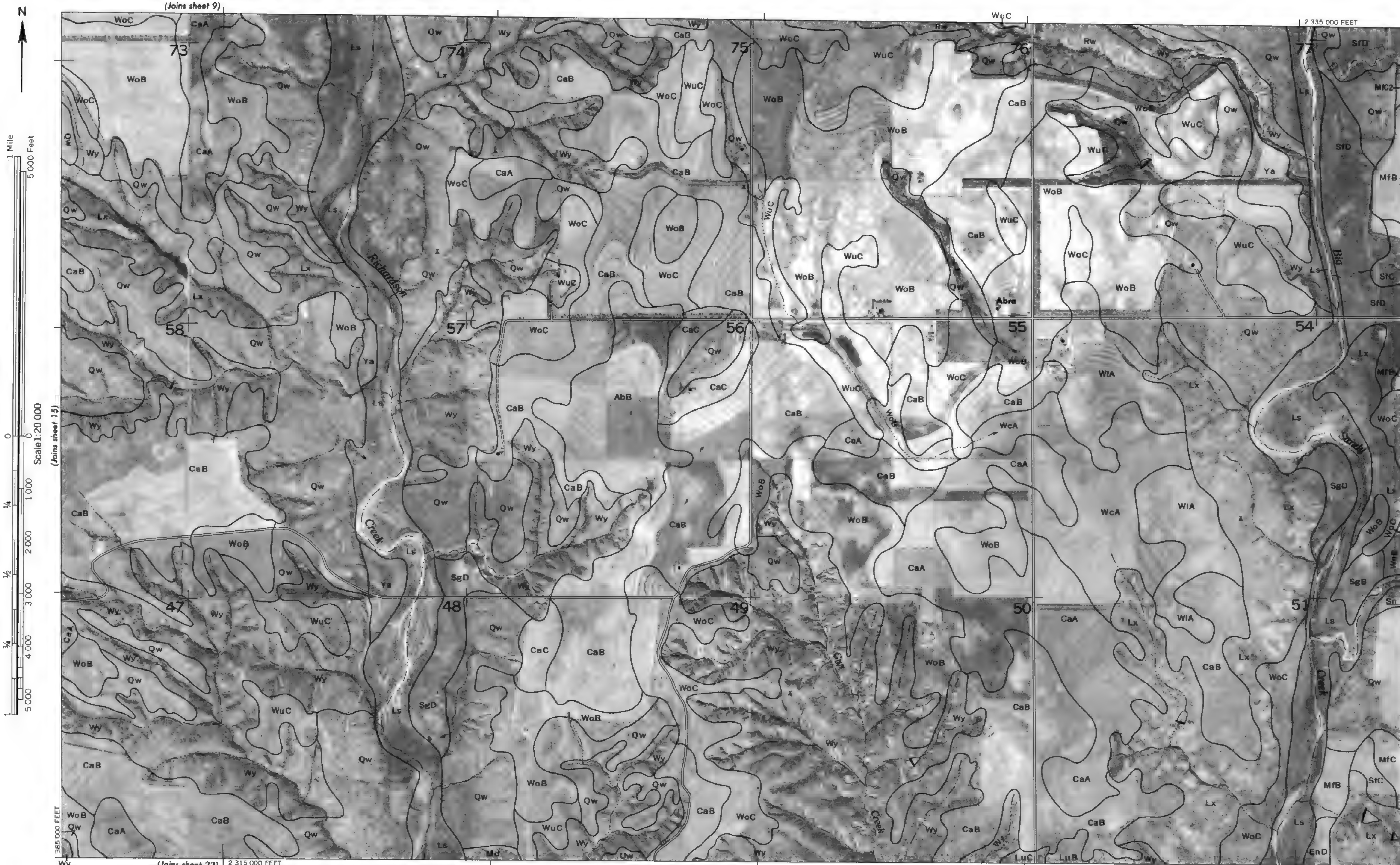
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone

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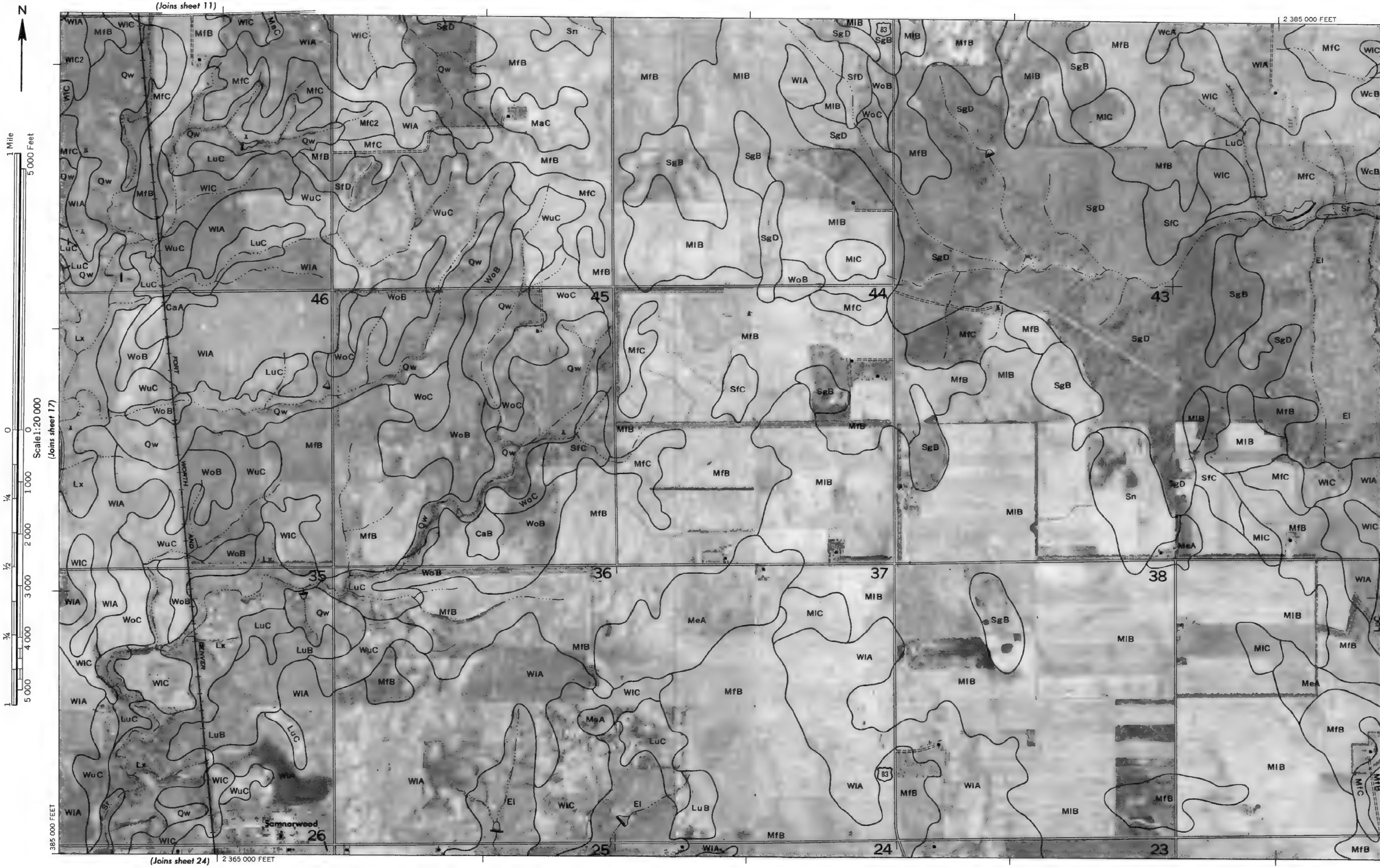
COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 17

(17)

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 18



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

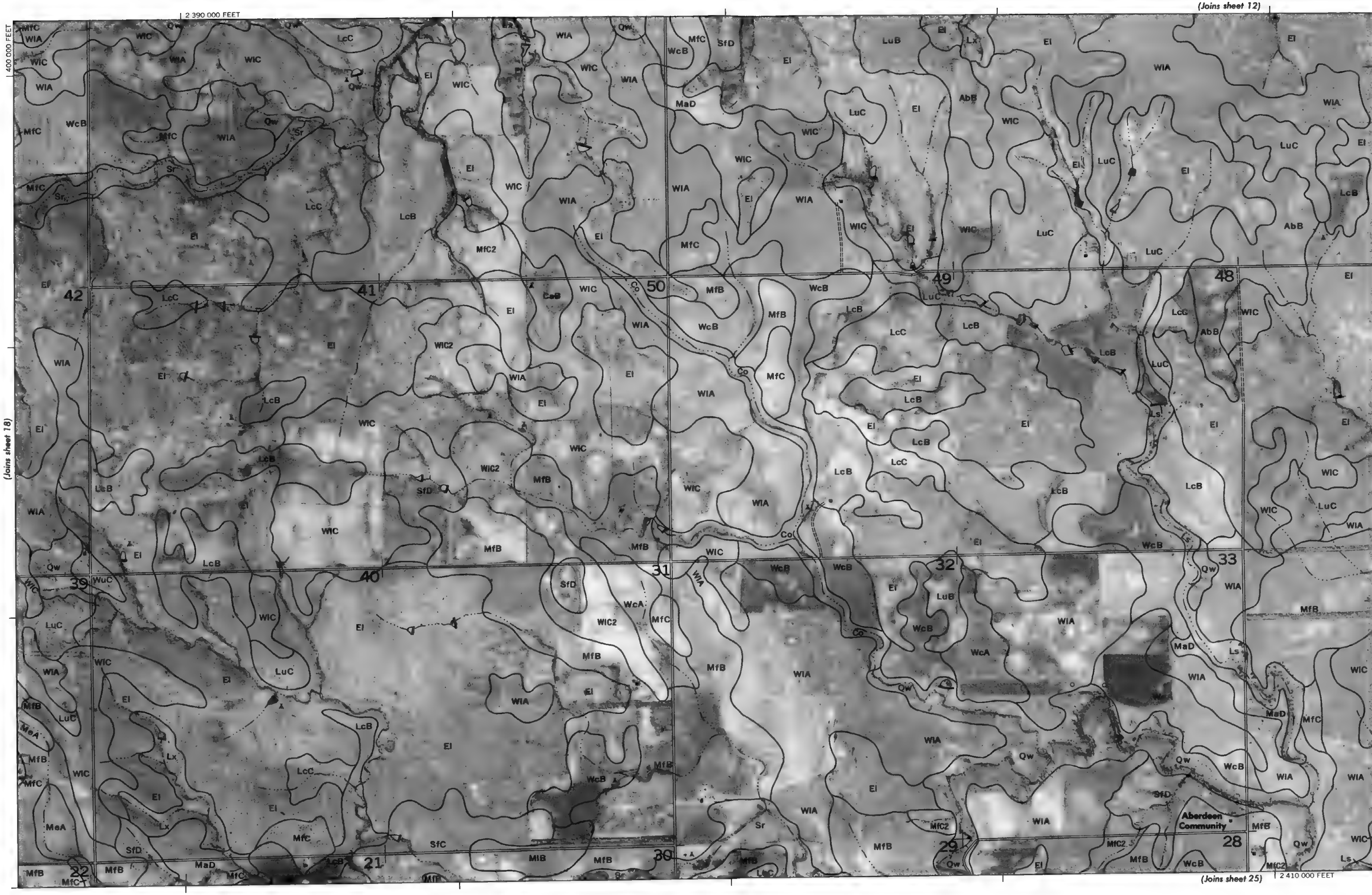
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

N

(Joins sheet 12)

2 390 000 FEET

400 000 FEET



(Joins sheet 18)

(Joins sheet 20)

(Joins sheet 25)

2 410 000 FEET

385 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

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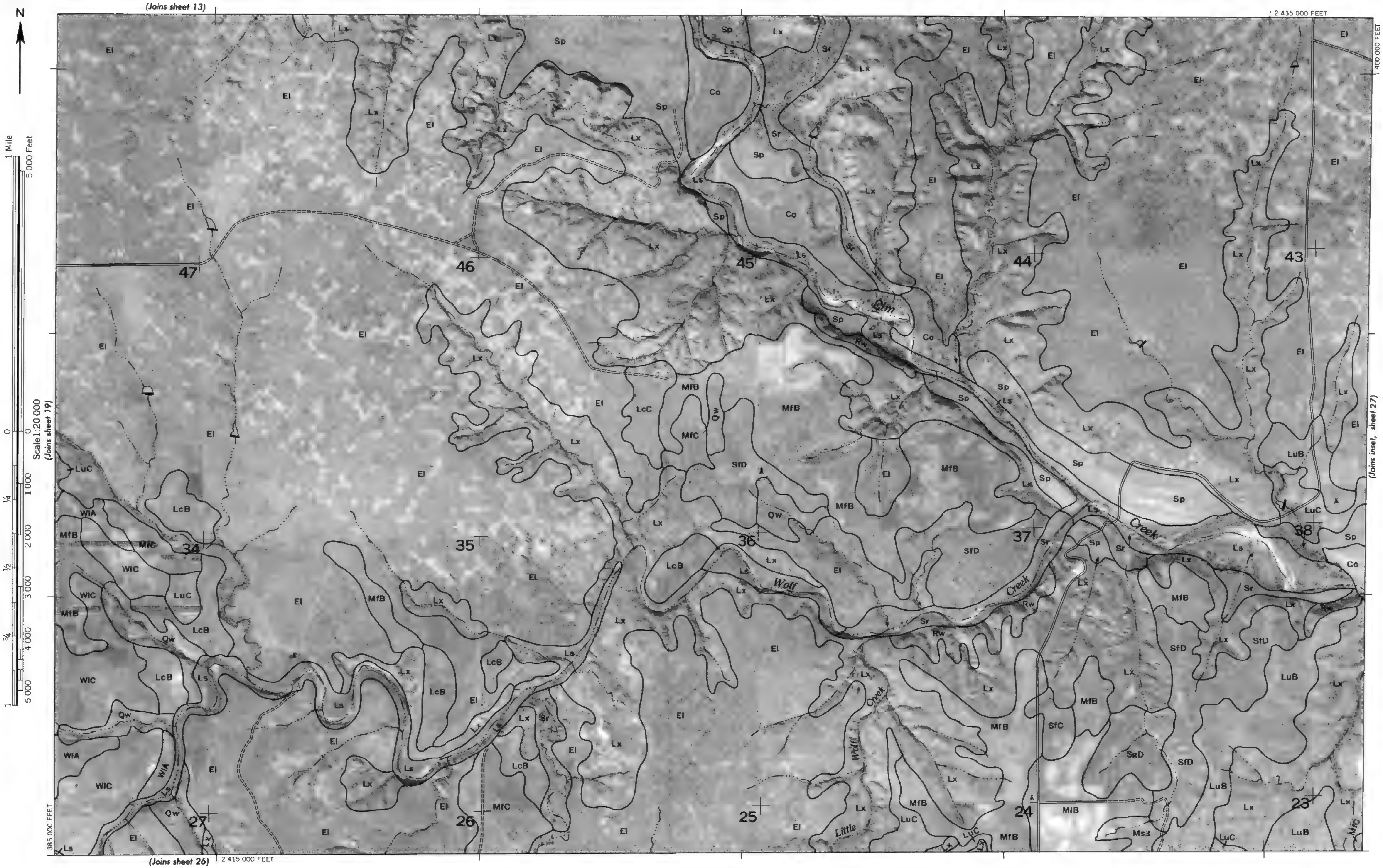
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 20

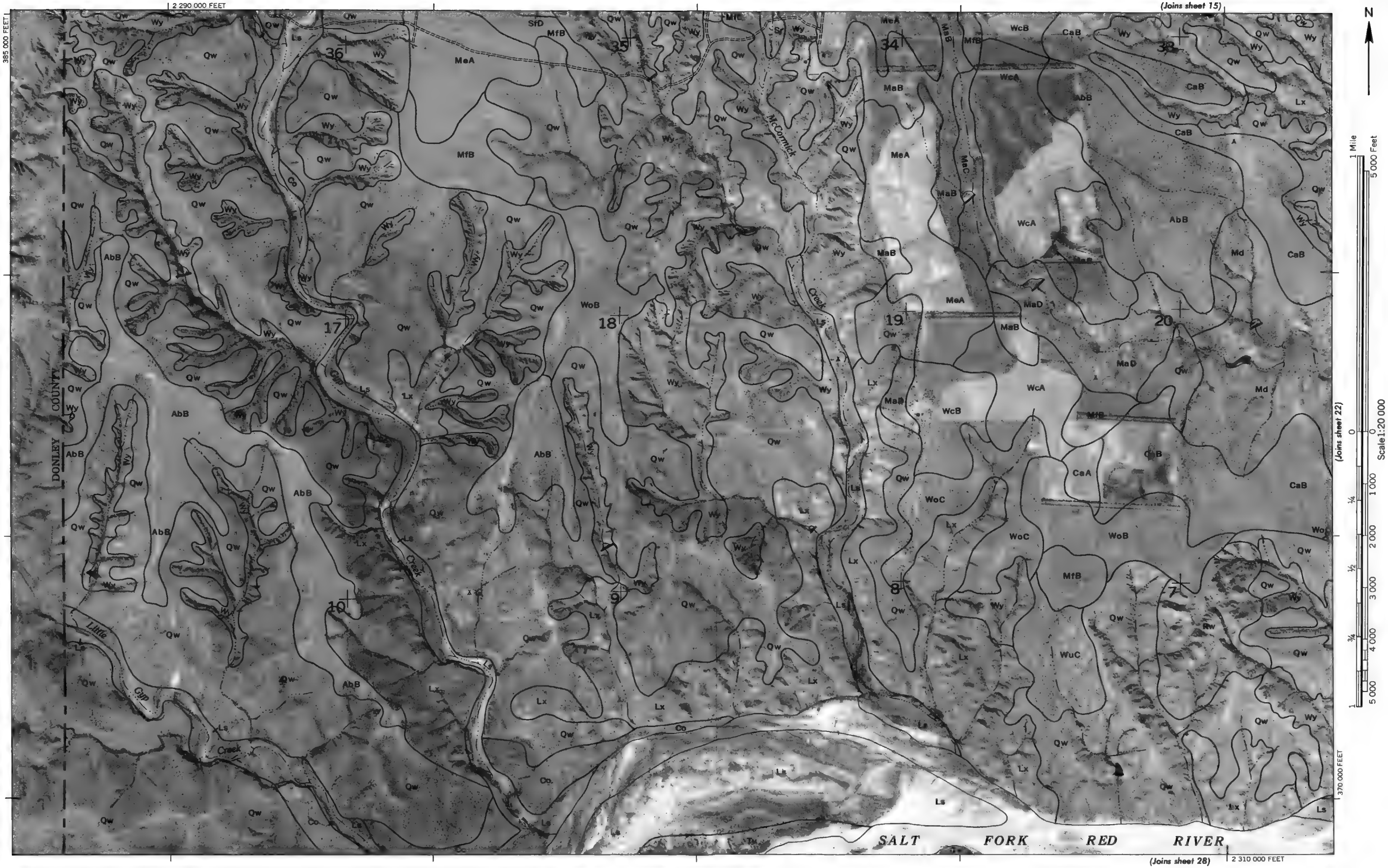


Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

21



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 22

N

1 Mile | 5 000 Feet

Scale 1:20 000

0 | ¼ | ½ | ¾ | 1

0 | 1 000 | 2 000 | 3 000 | 4 000 | 5 000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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Land division corners are approximately positioned on this map.

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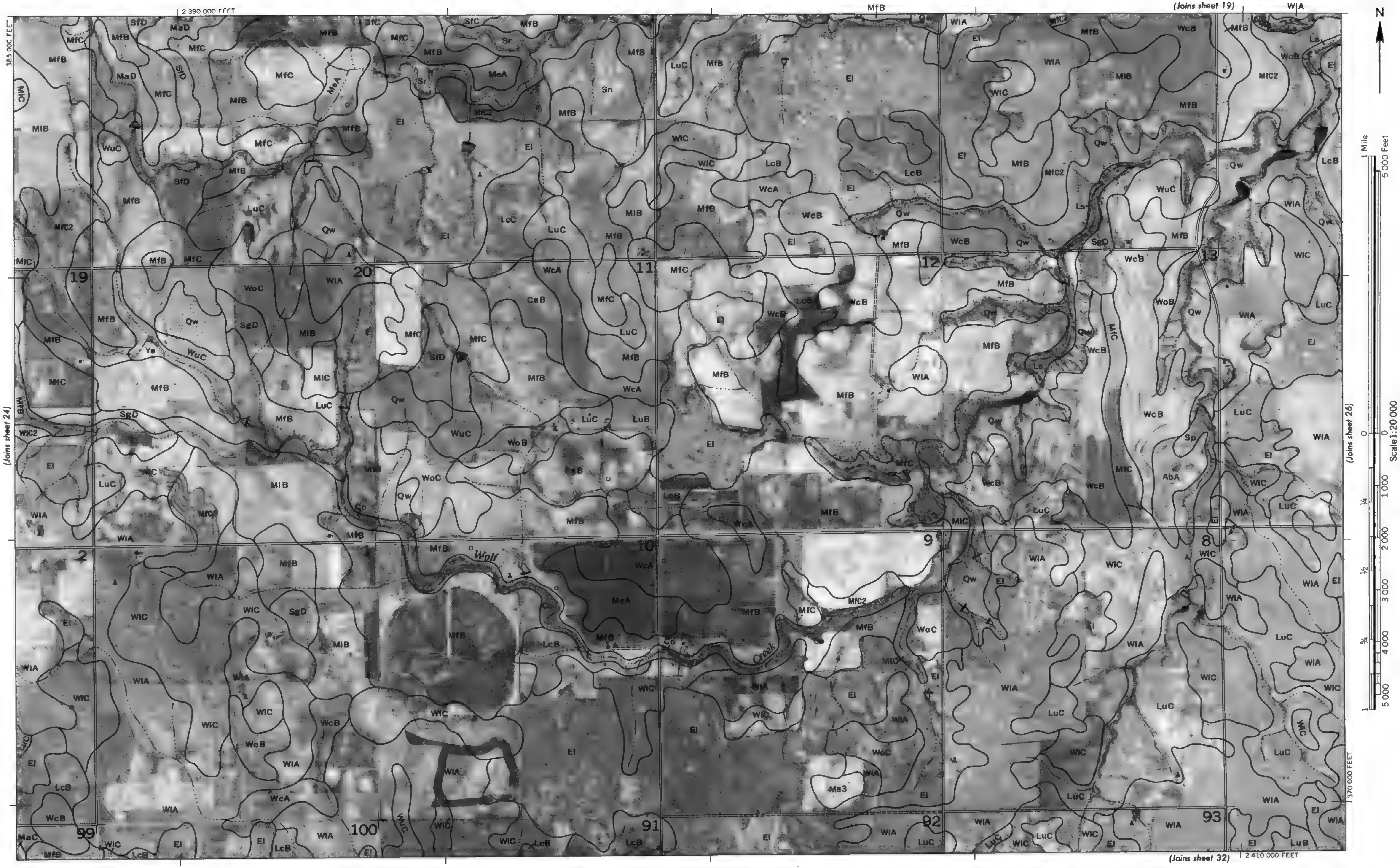

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 26

N

Scale 1:20 000

1 Mile

5 000 Feet

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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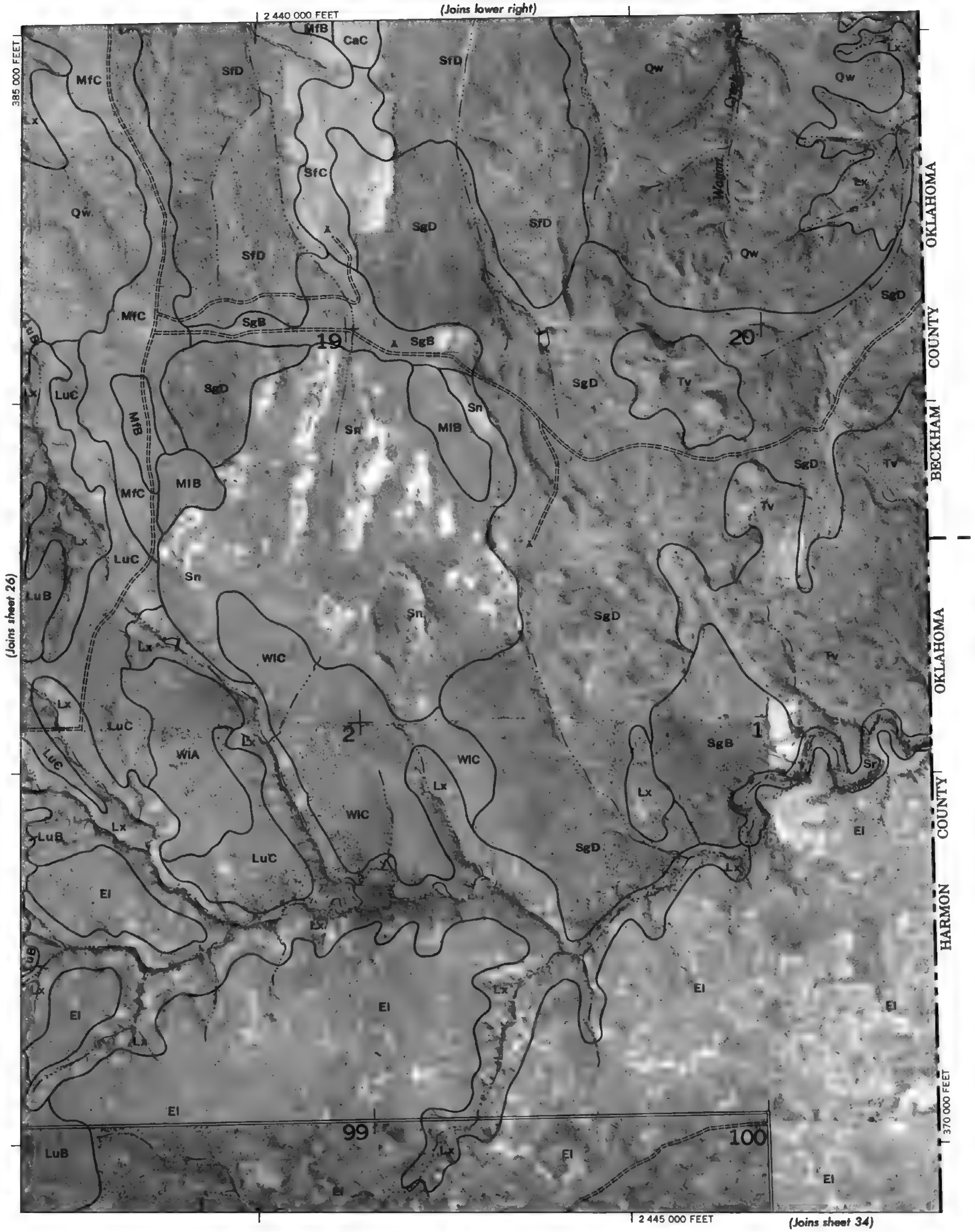
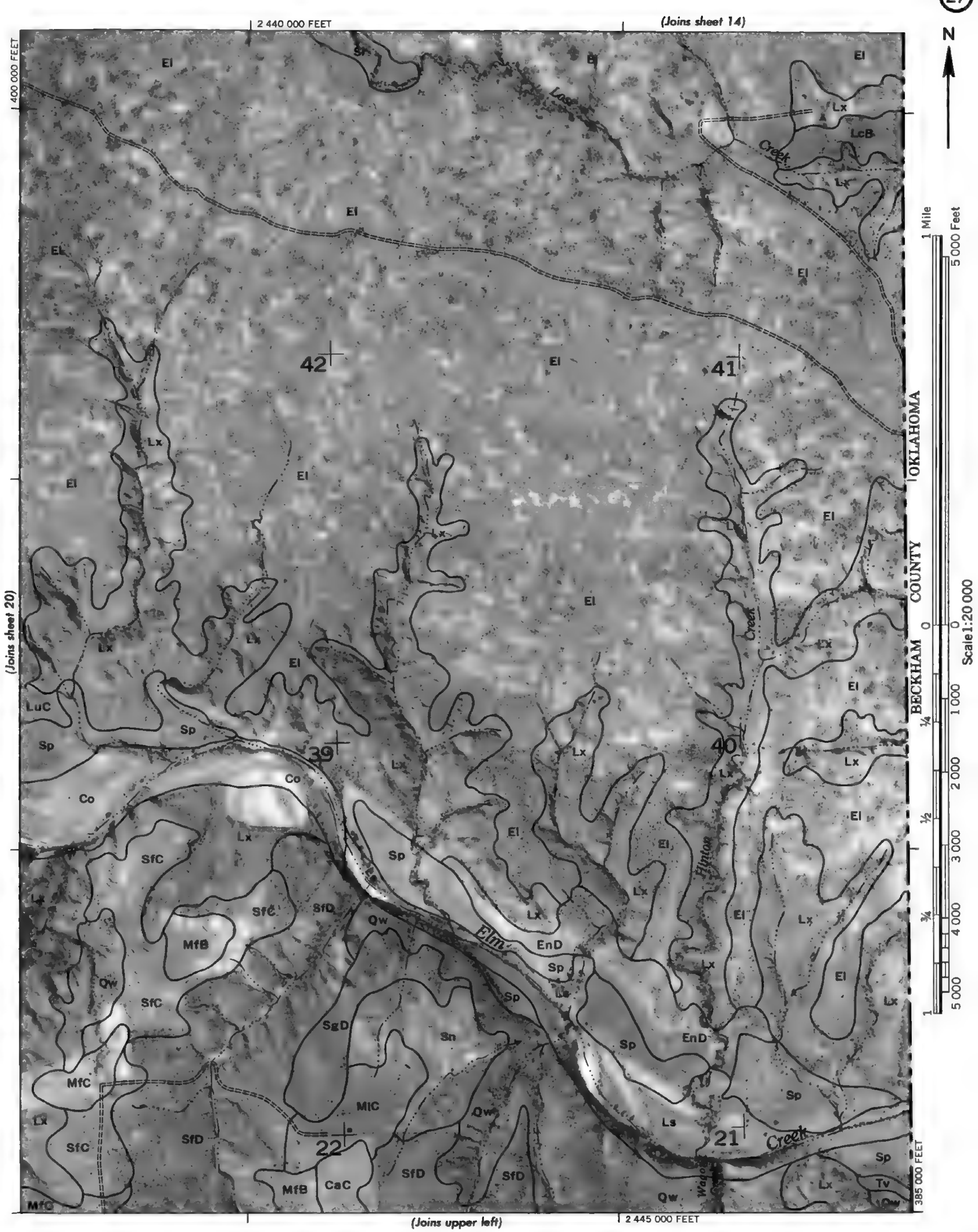
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.





28

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 28

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 29

29

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

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Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

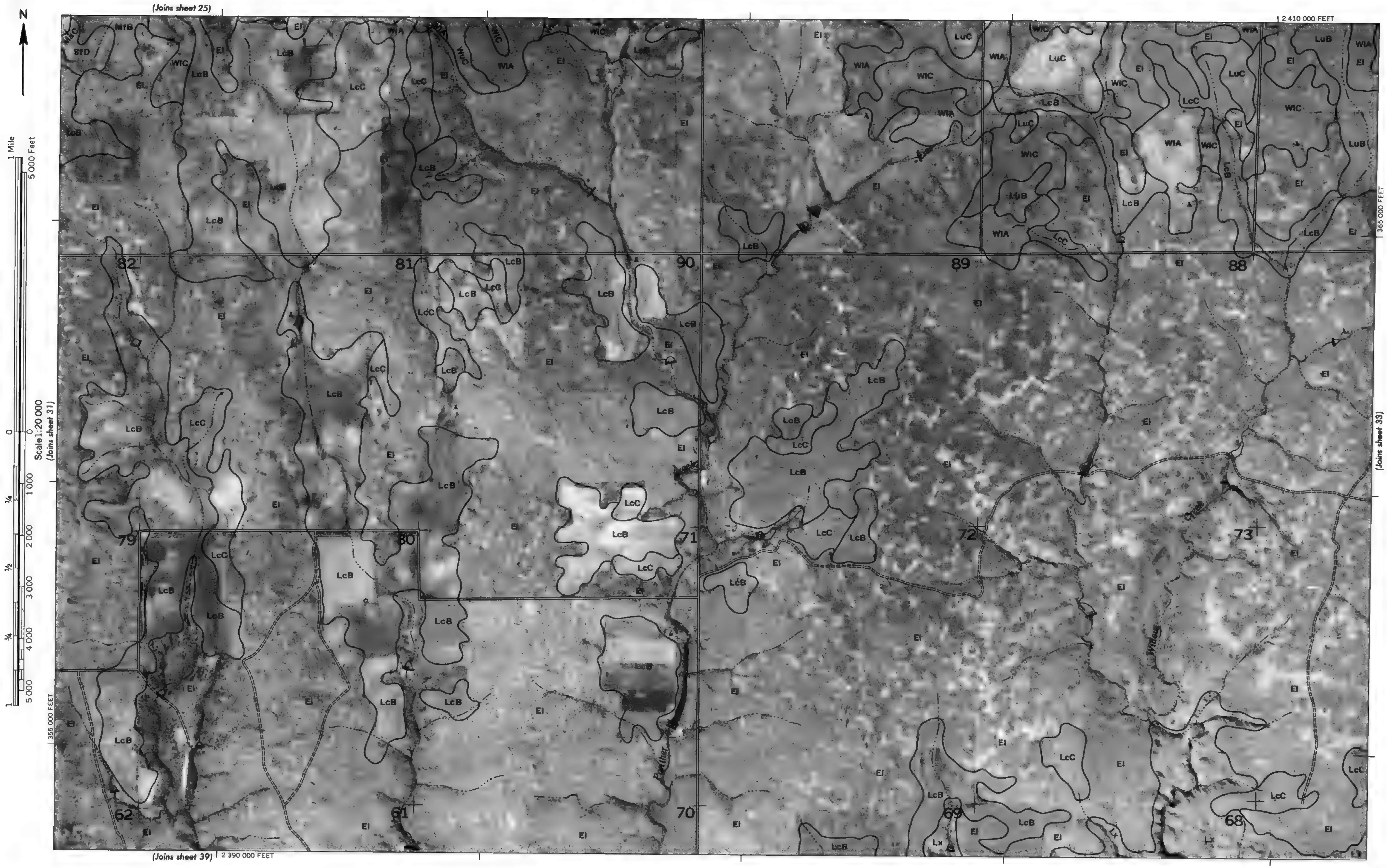
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

N

1 Mile
5 000 Feet
0 ¼ ½ ¾ 1
0 1 000 2 000 3 000 4 000 5 000
Scale 1:20 000

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 32



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 33

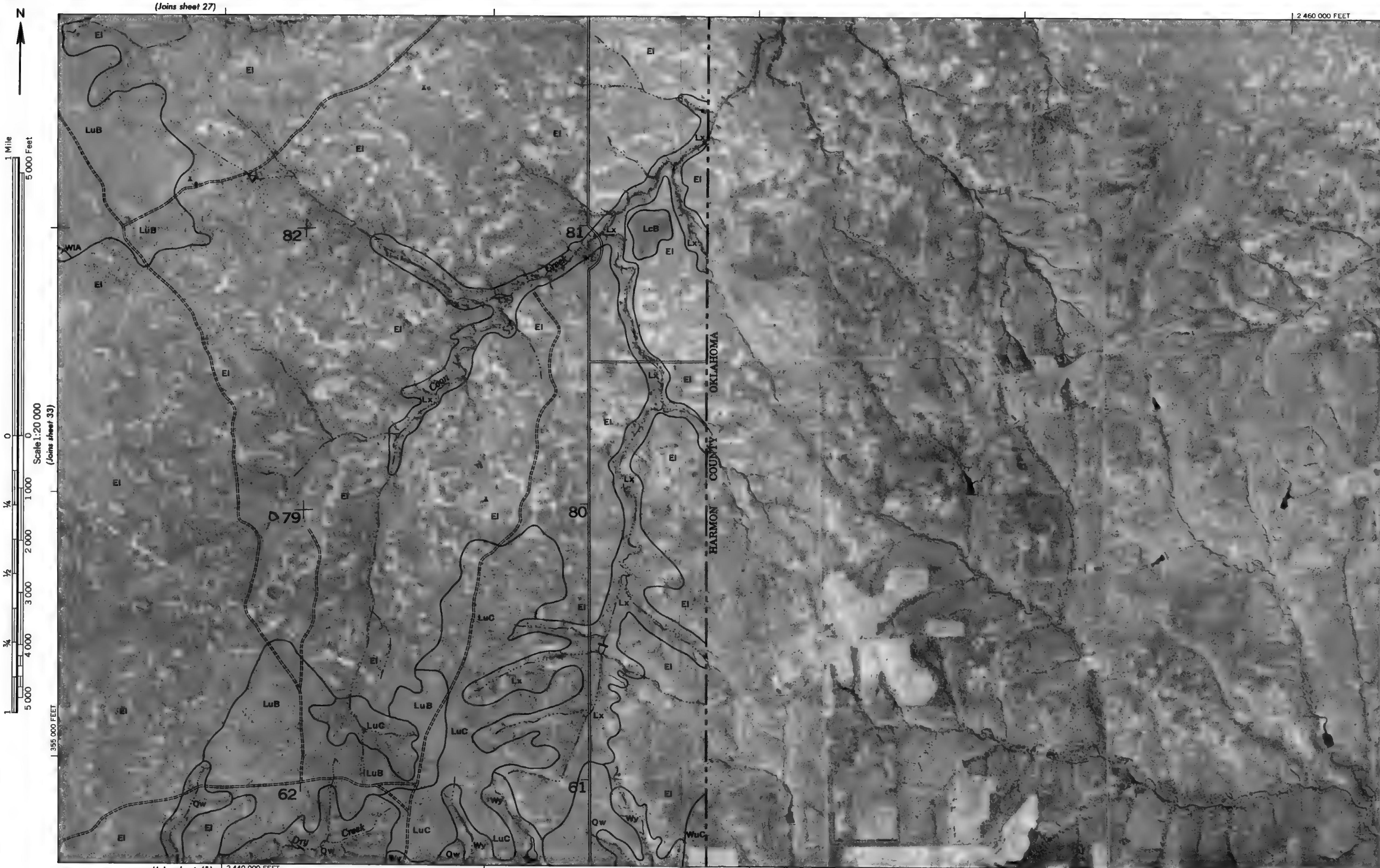
33

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 34



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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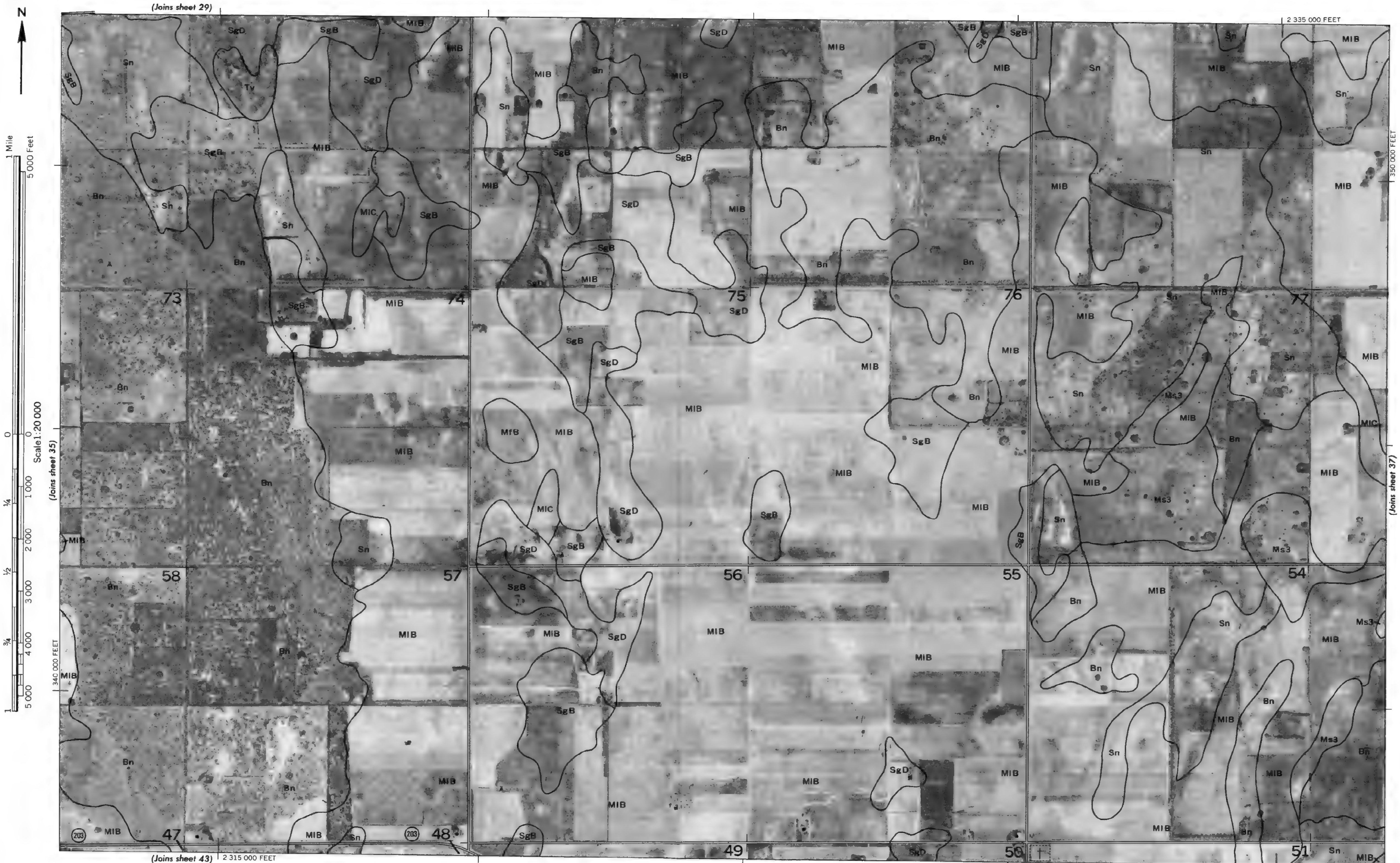

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone

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Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 38

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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39

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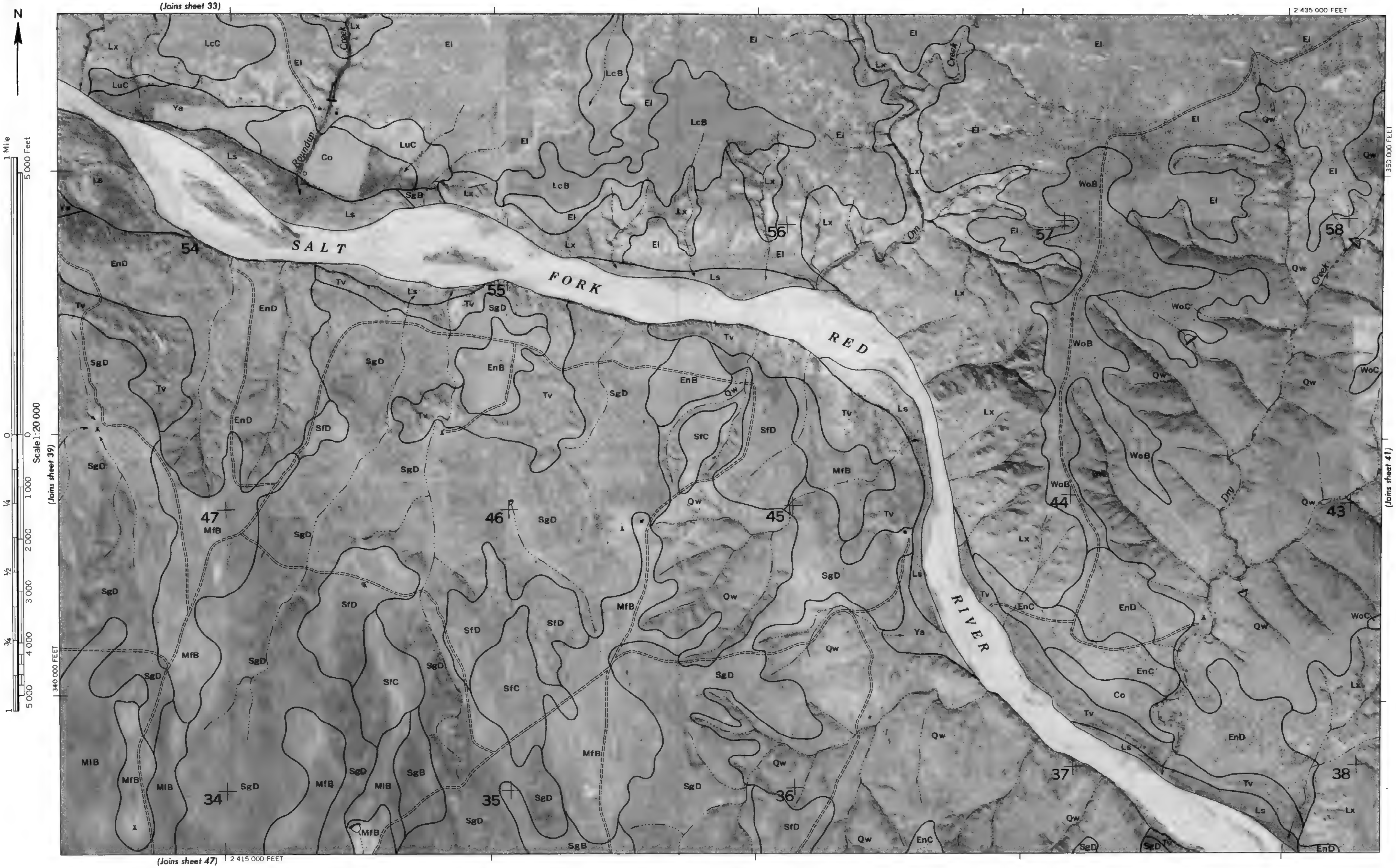
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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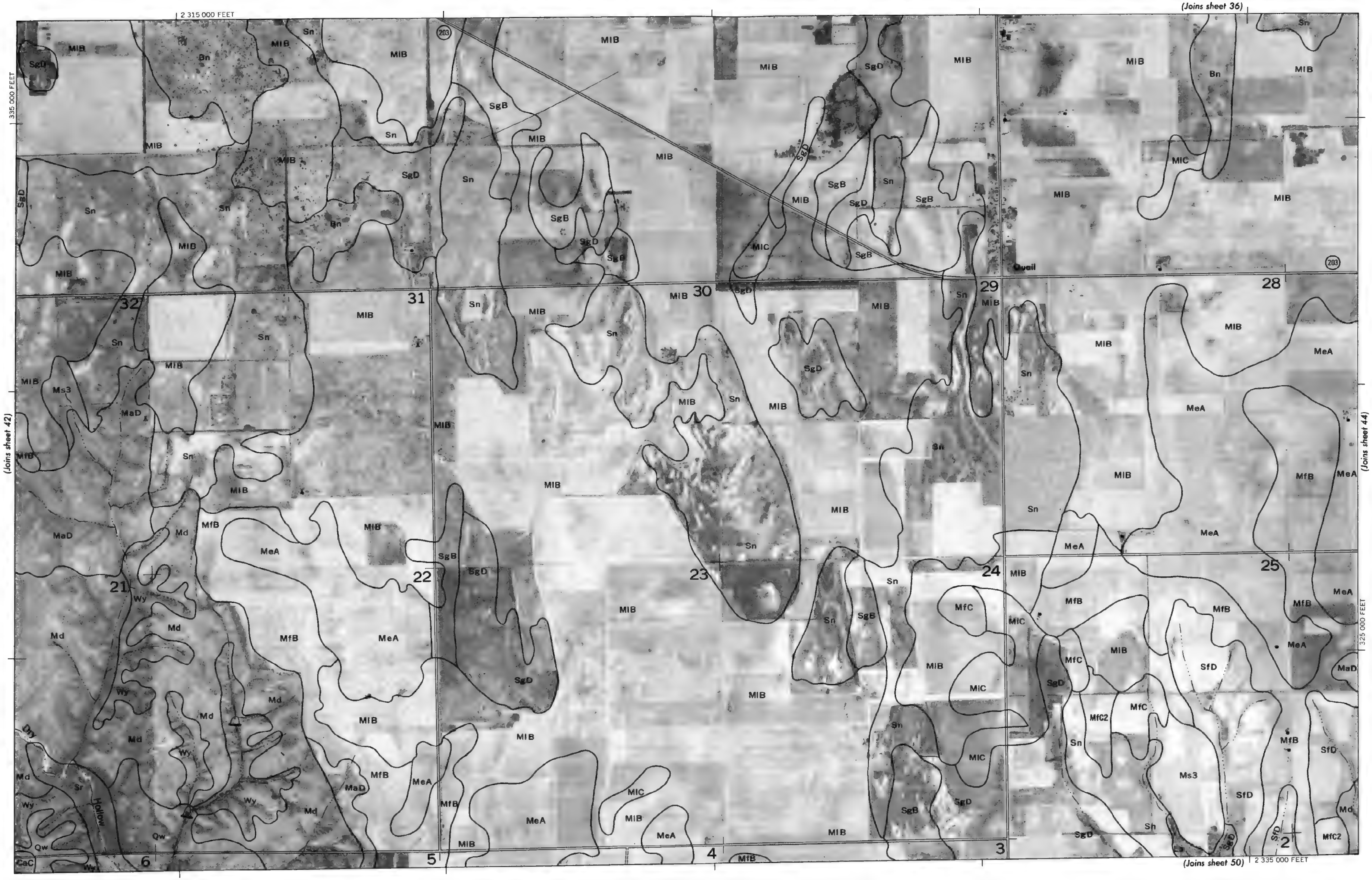
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 42

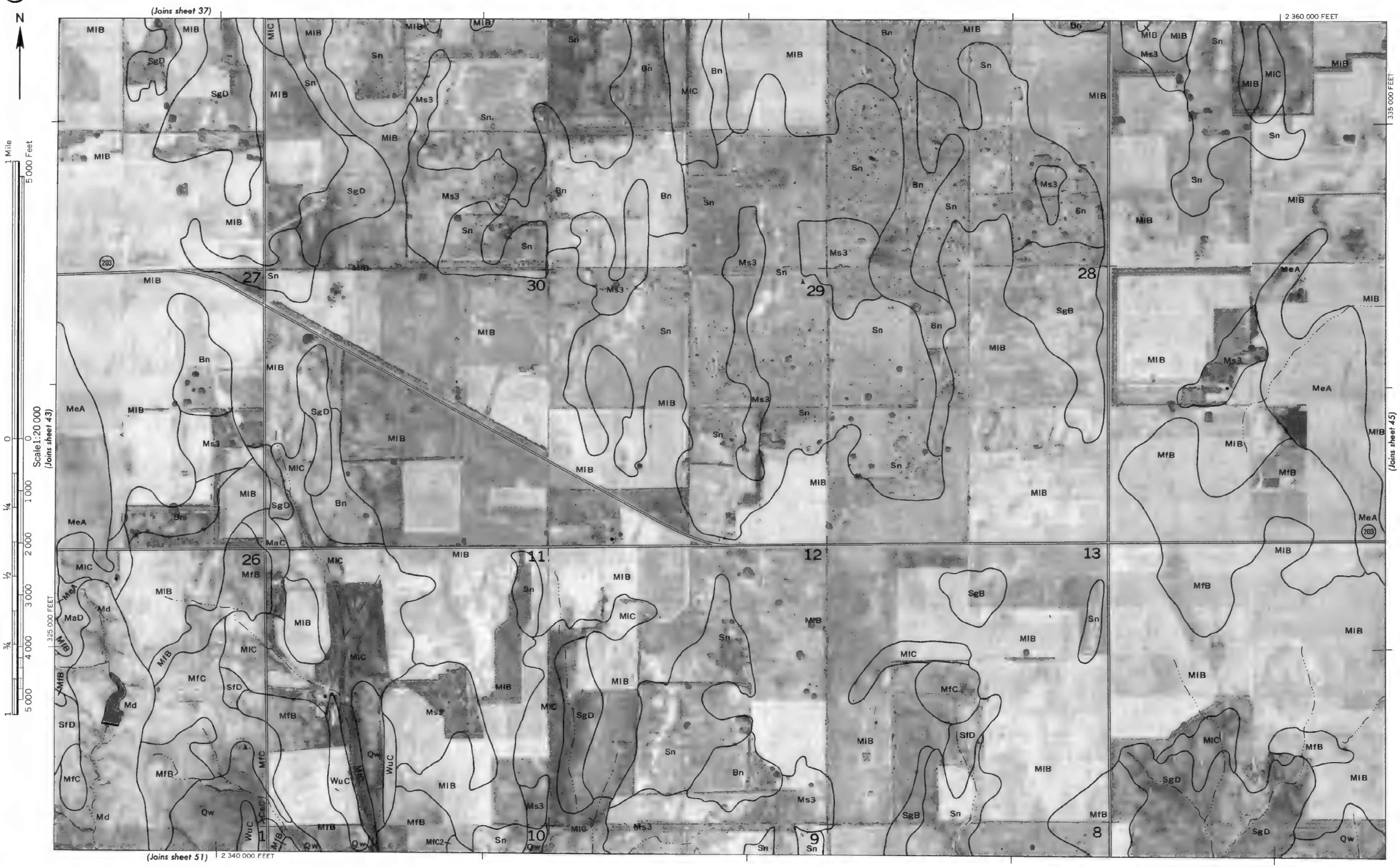
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

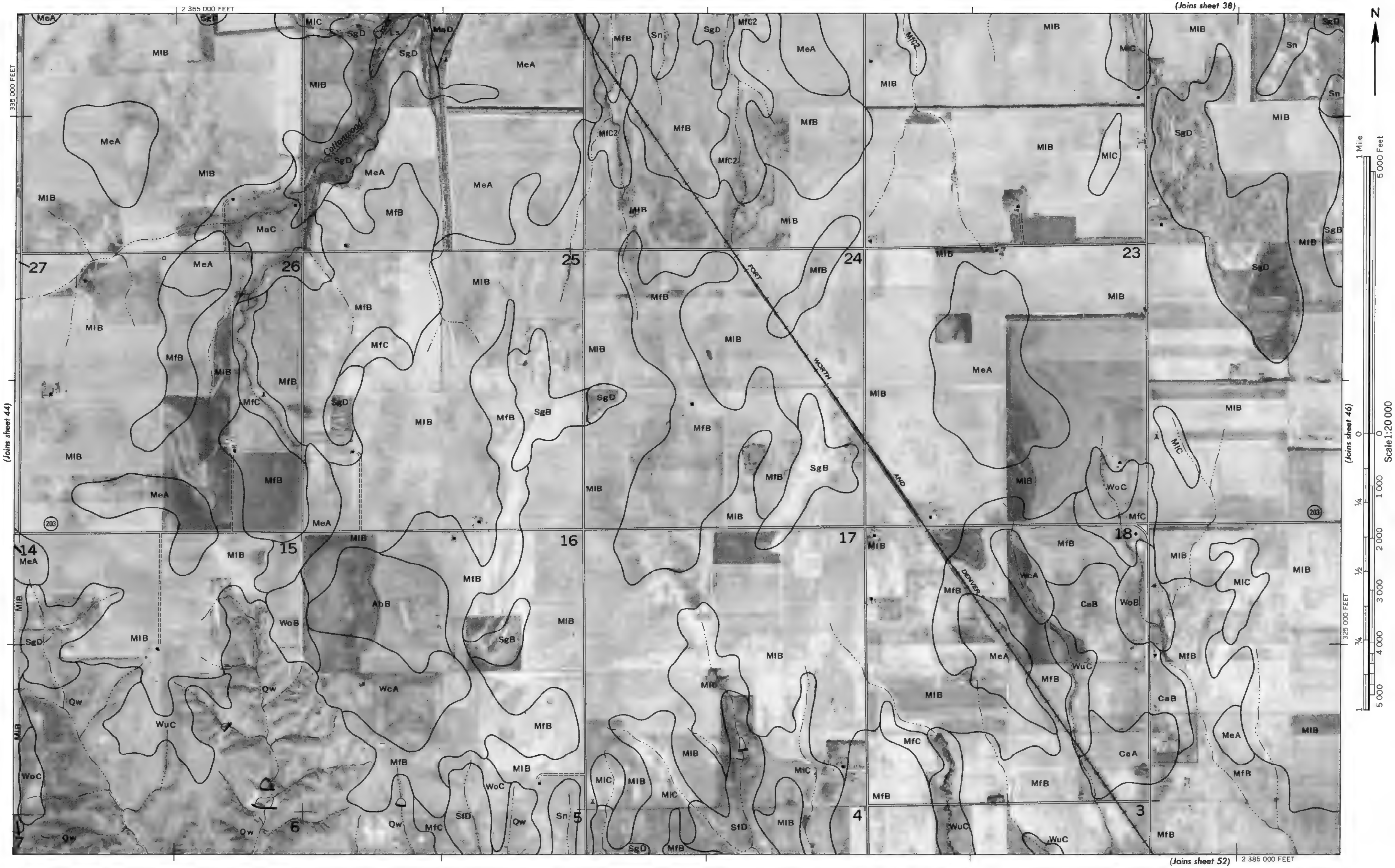
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 45

45

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.



46

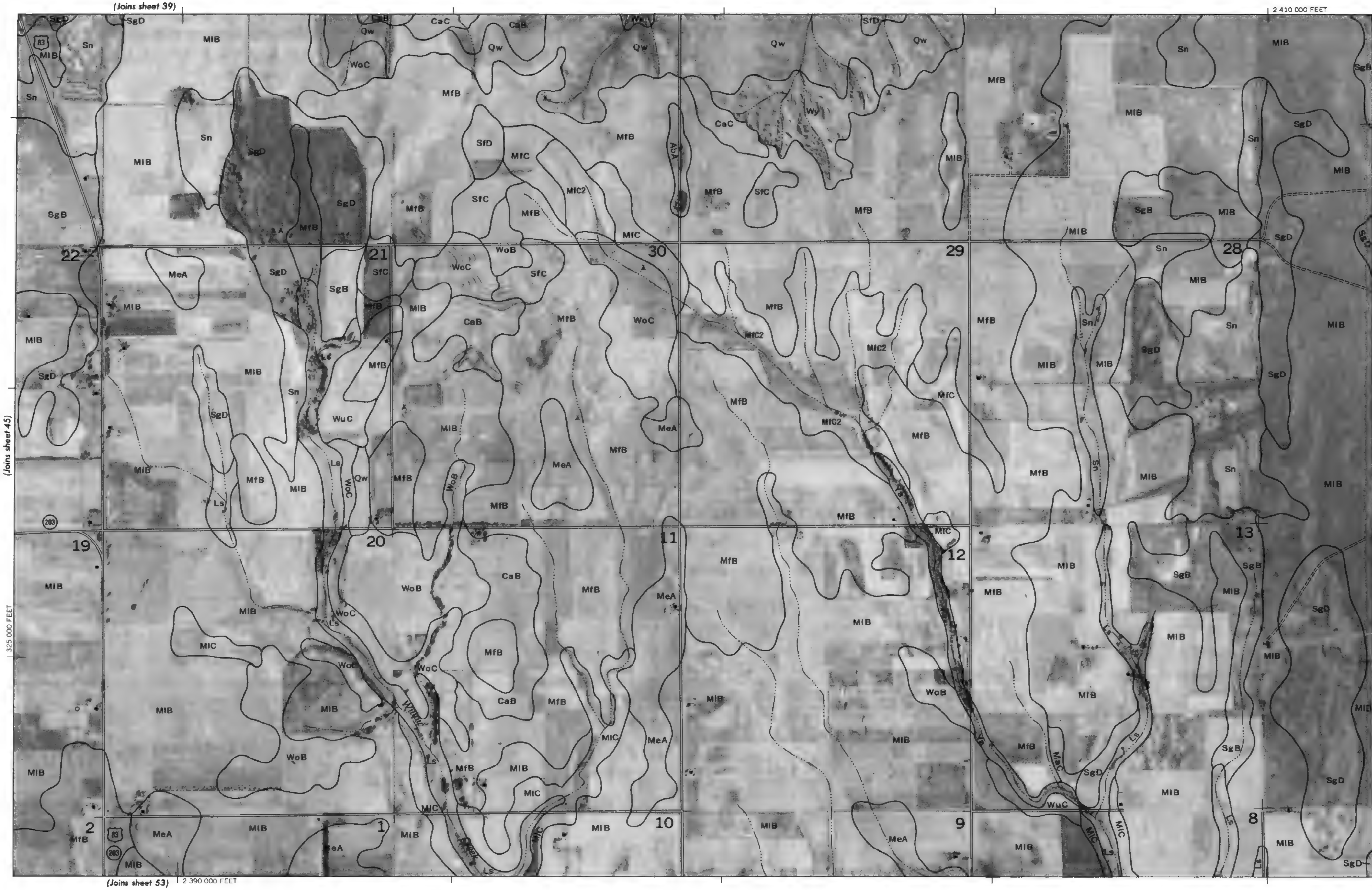
COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 46

N

Scale 1:20 000

1 Mile ¾ ½ ¼ 0

5 000 Feet 4 000 3 000 2 000 1 000 0



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 47

47

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 48

N

1 Mile
5 000 Feet
Scale 1:20 000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone

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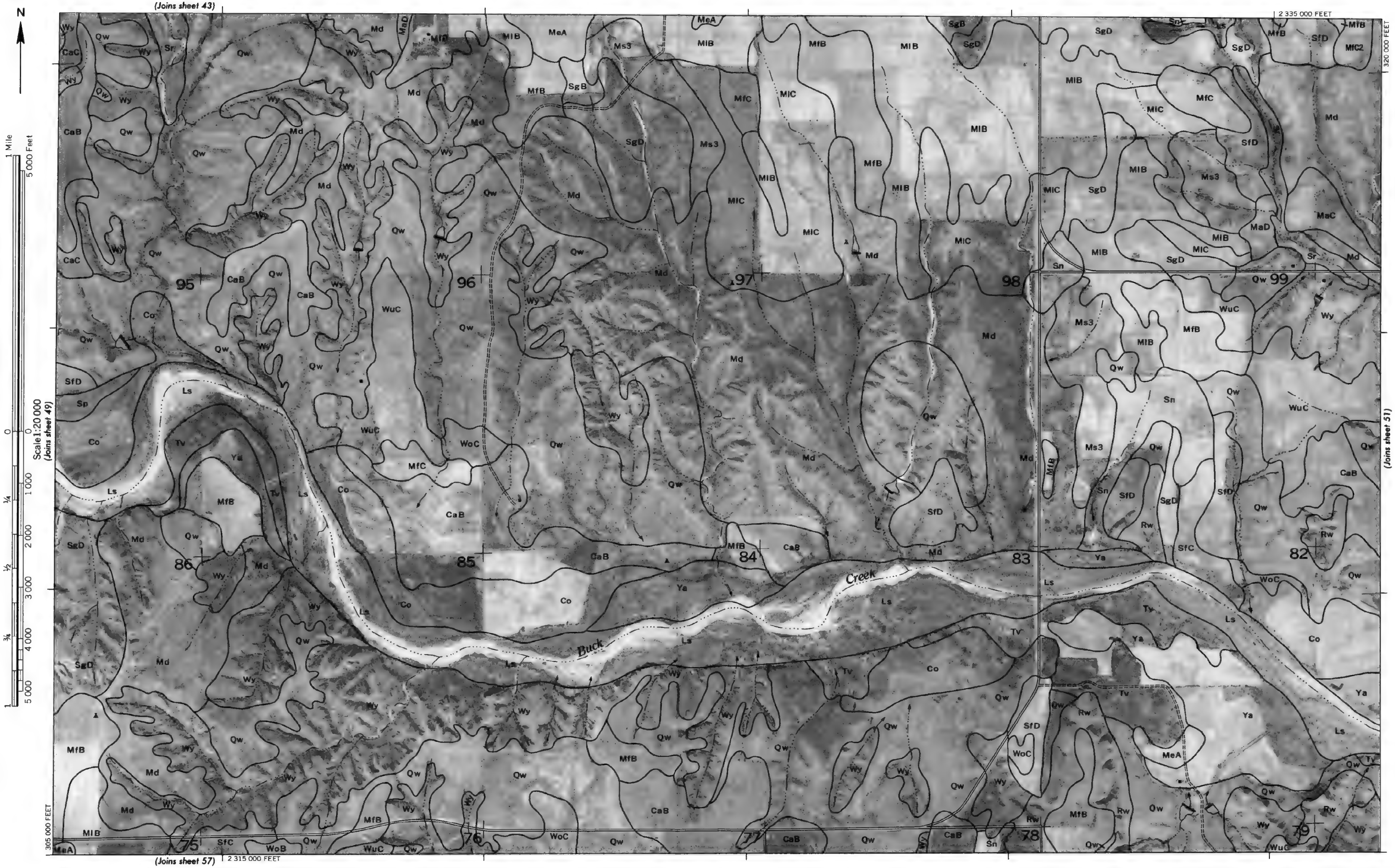
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 50



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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2 340 000 FEET

(Joins sheet 44)

320 000 FEET

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 58)

2 360 000 FEET

305 000 FEET

N

1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 52

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

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Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 54

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

N

1 Mile | 5 000 Feet | 0 | 1/4 | 1/2 | 3/4 | 1 | 1000 | 2000 | 3000 | 4000 | 5 000

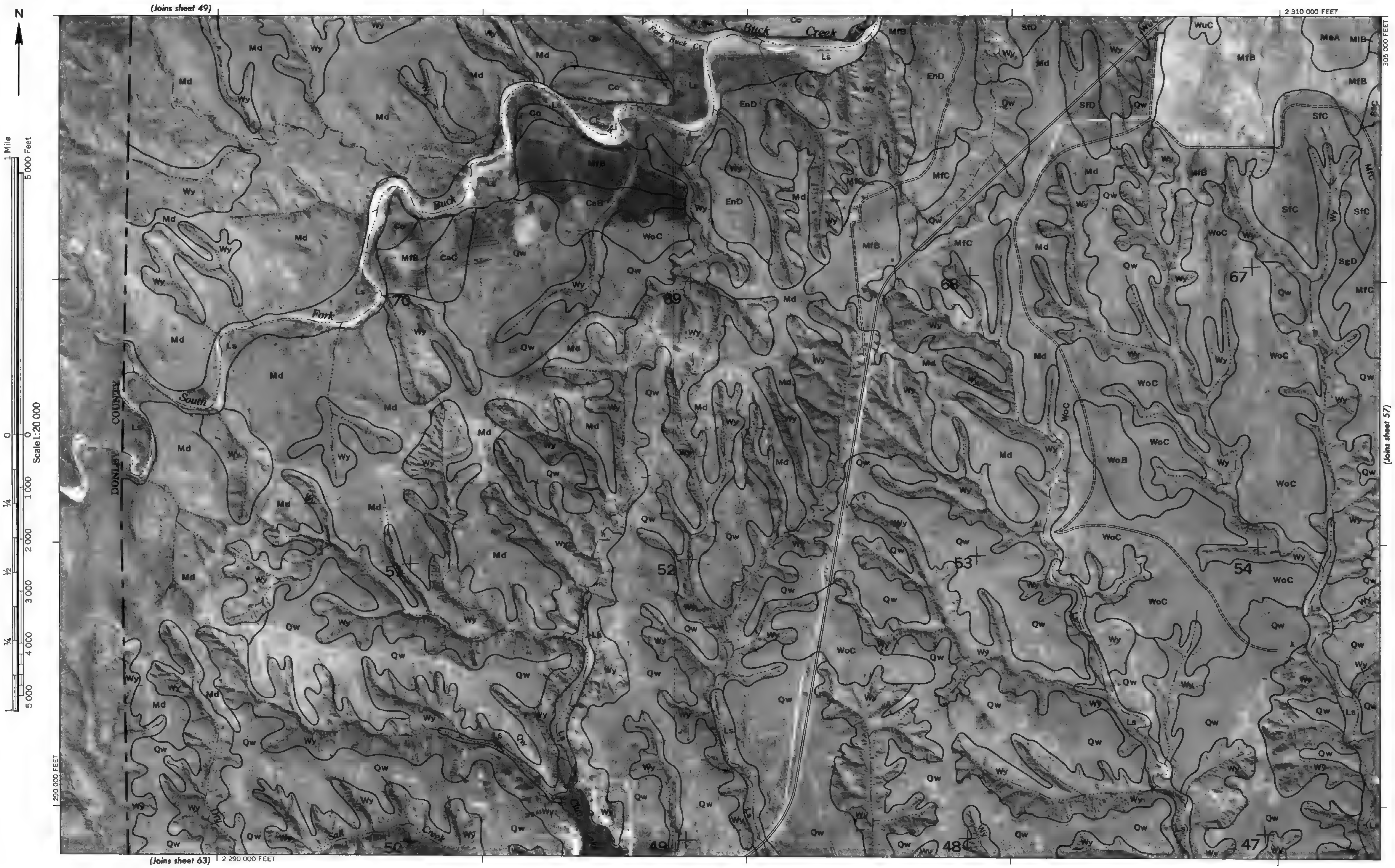
Scale 1:20 000

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

Land division corners are approximately positioned on this map.

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 56



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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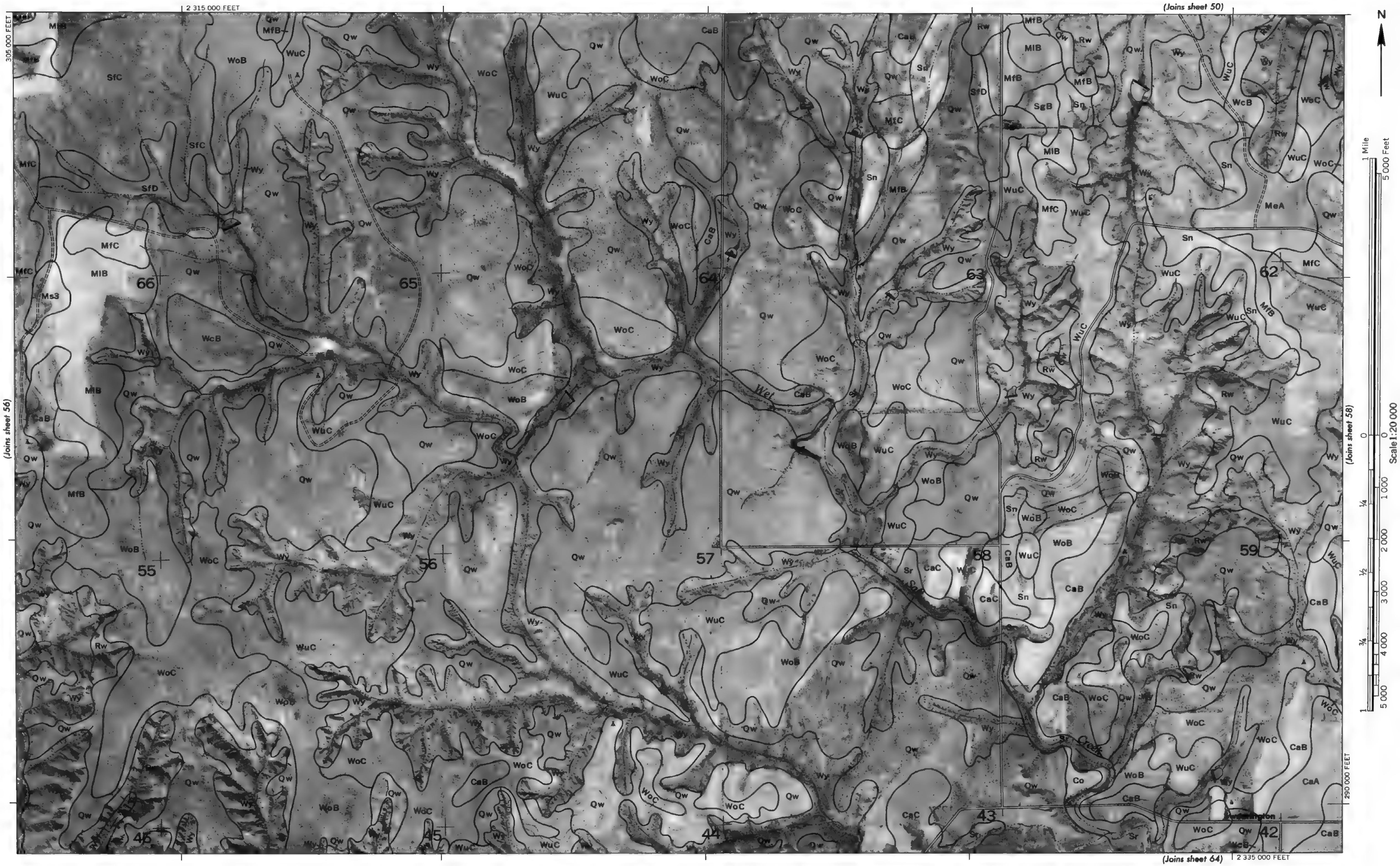
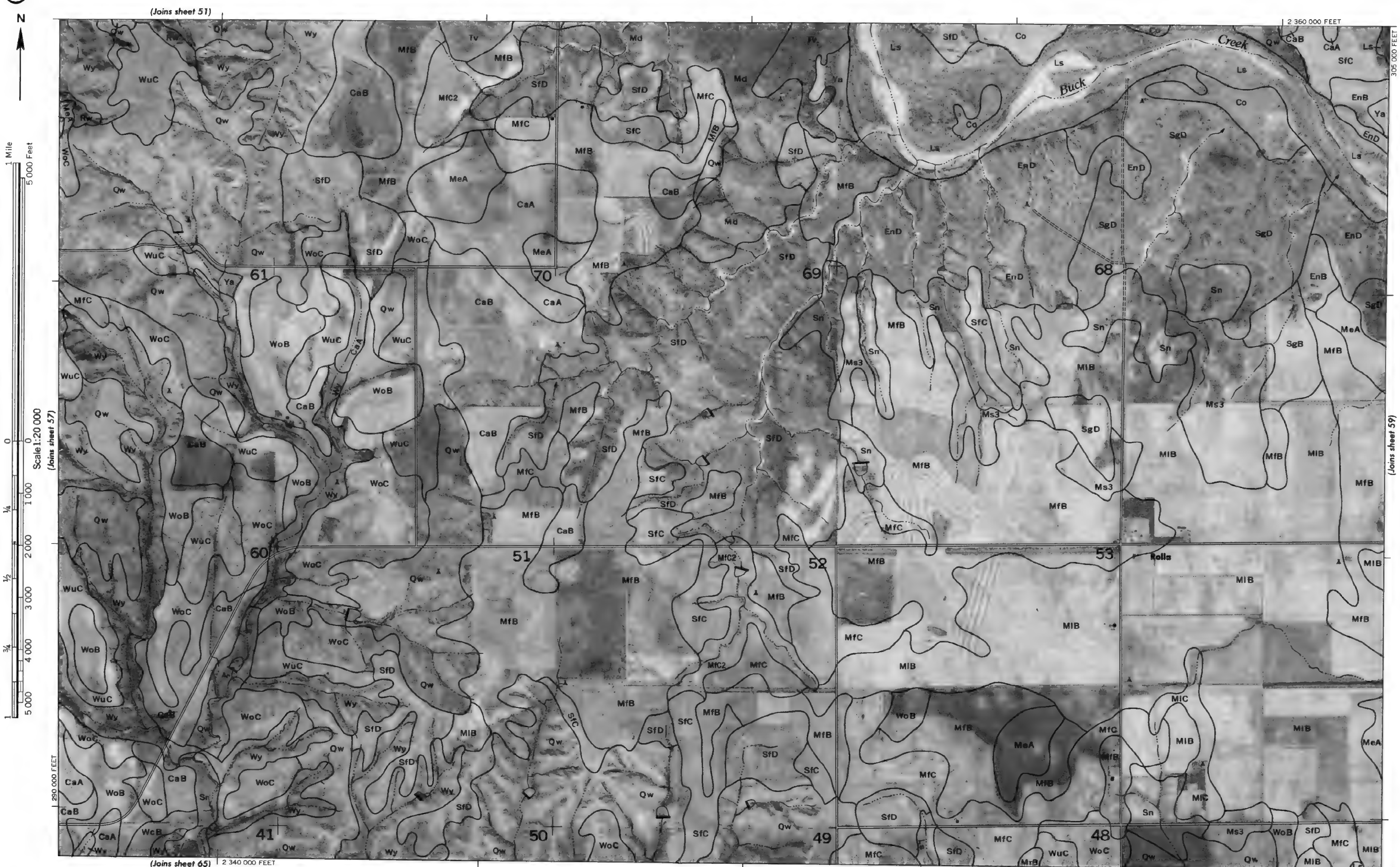
57

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.





Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone

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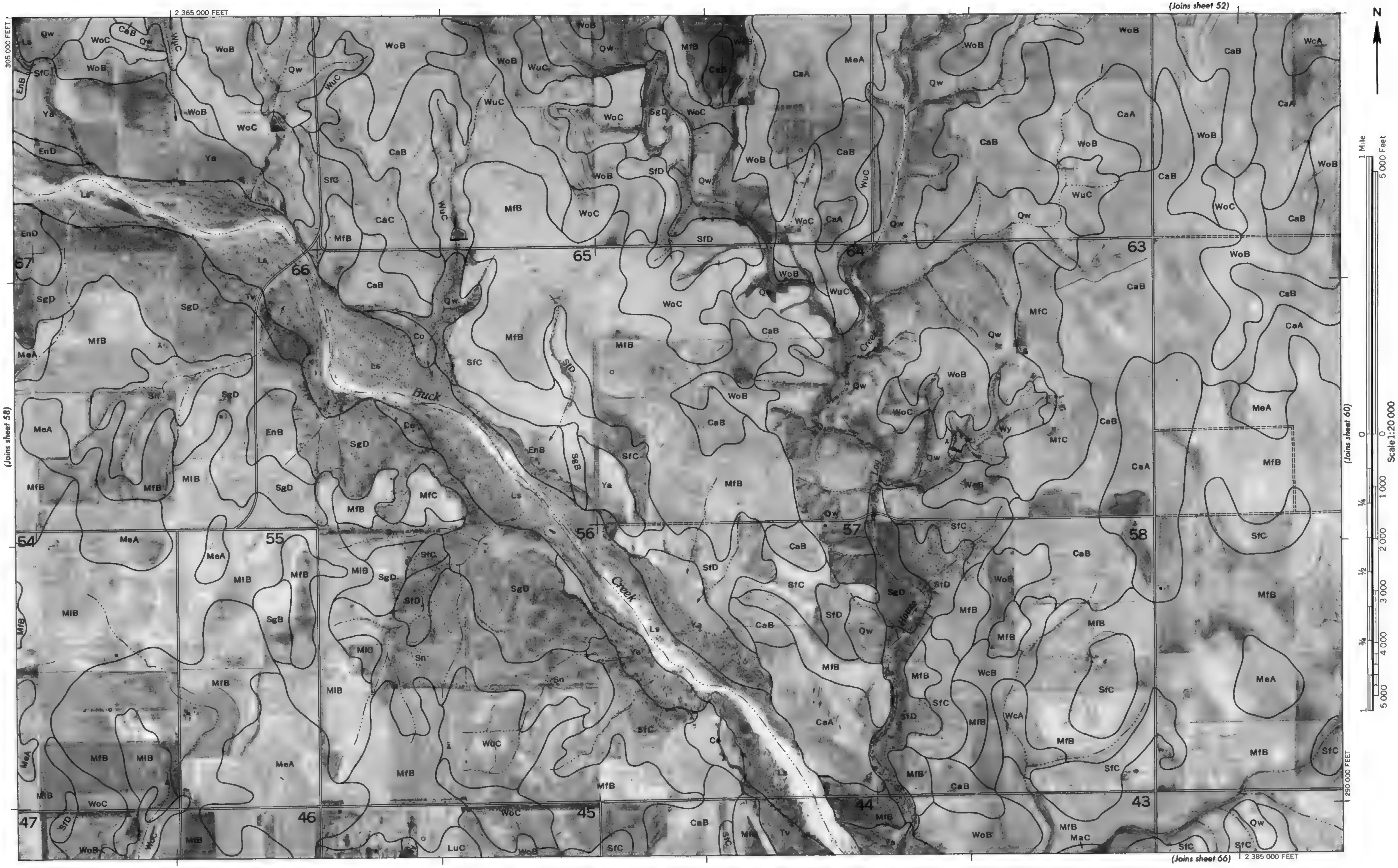
59



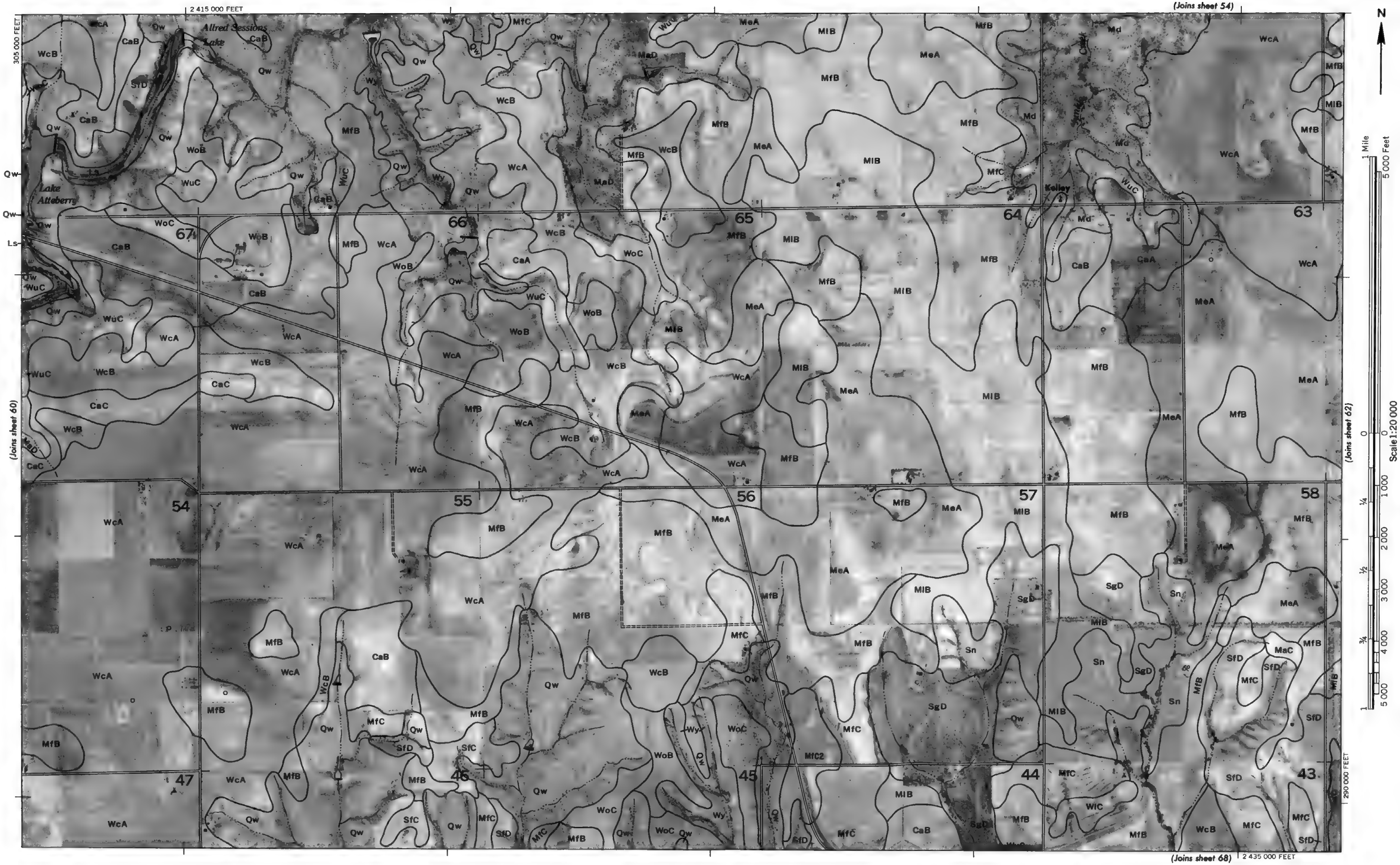
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

(60)

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 60

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

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Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

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63

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.
Land division corners are approximately positioned on this map.

N

Scale 1:20 000

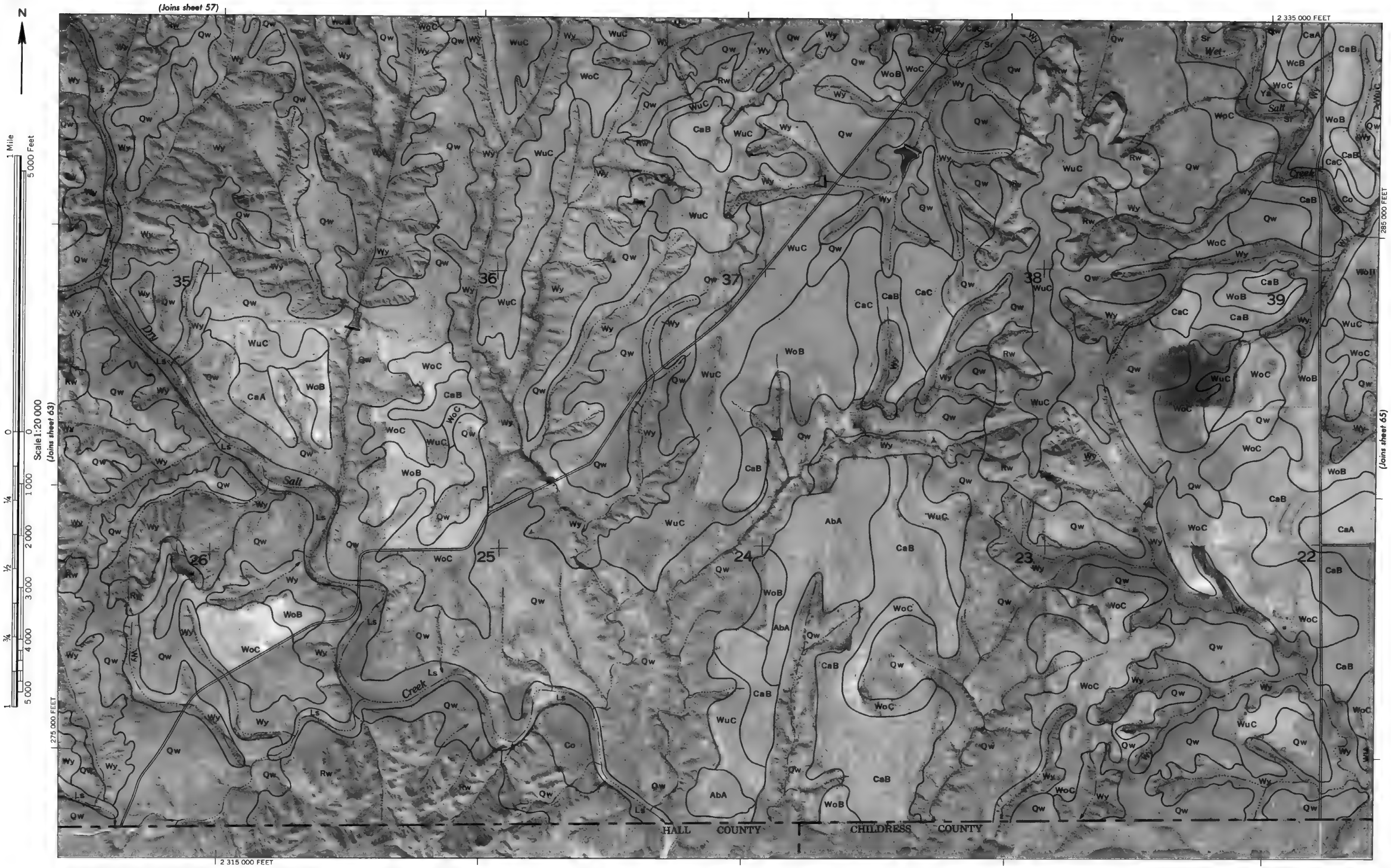
1 Mile

5 000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 64



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Texas coordinate system, north zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

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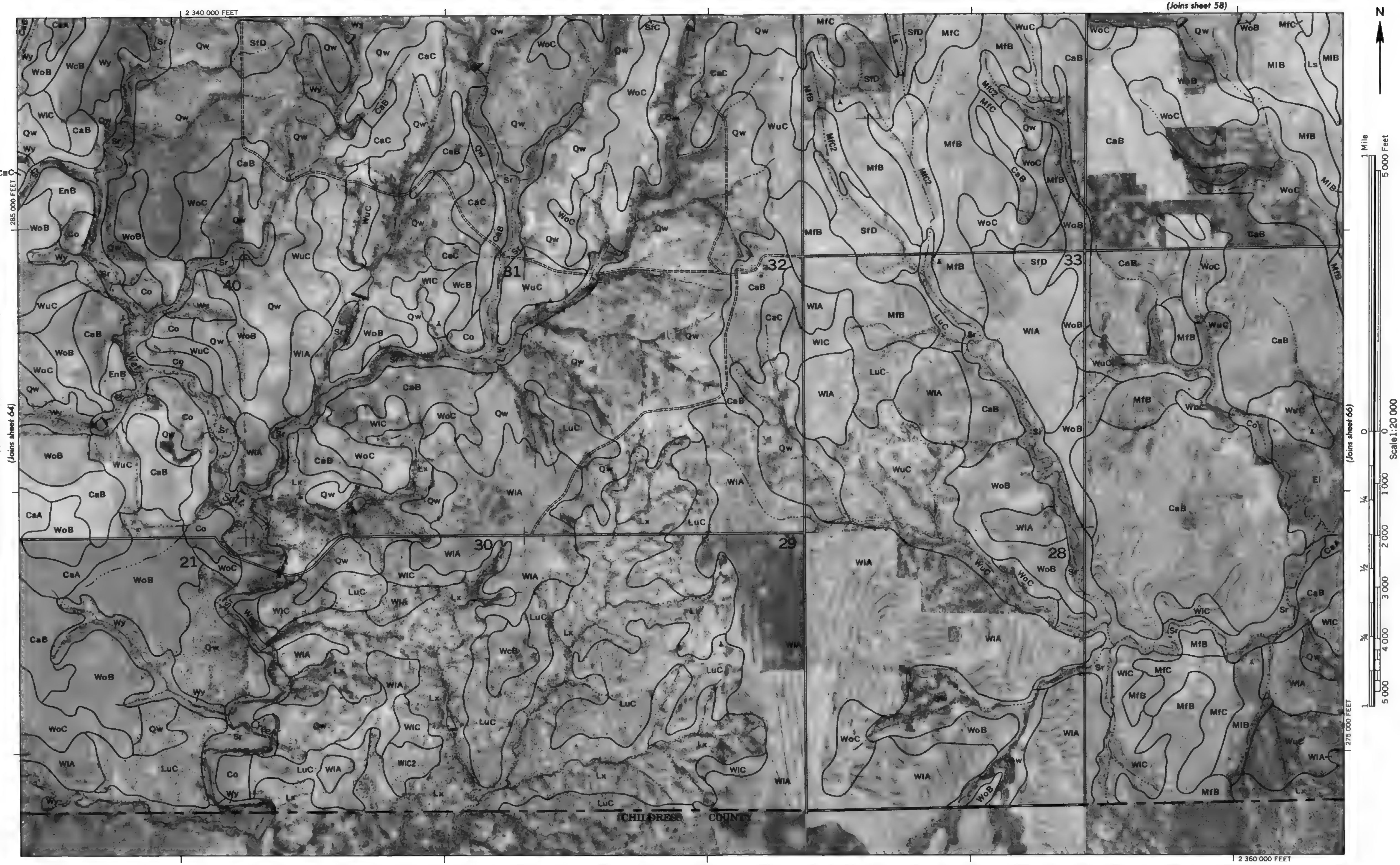

COLLINGSWORTH COUNTY, TEXAS — SHEET NUMBER 66

N

Scale 1:20 000

1 Mile — 0, 1/4, 1/2, 3/4, 1

5 000 Feet — 0, 1 000, 2 000, 3 000, 4 000, 5 000

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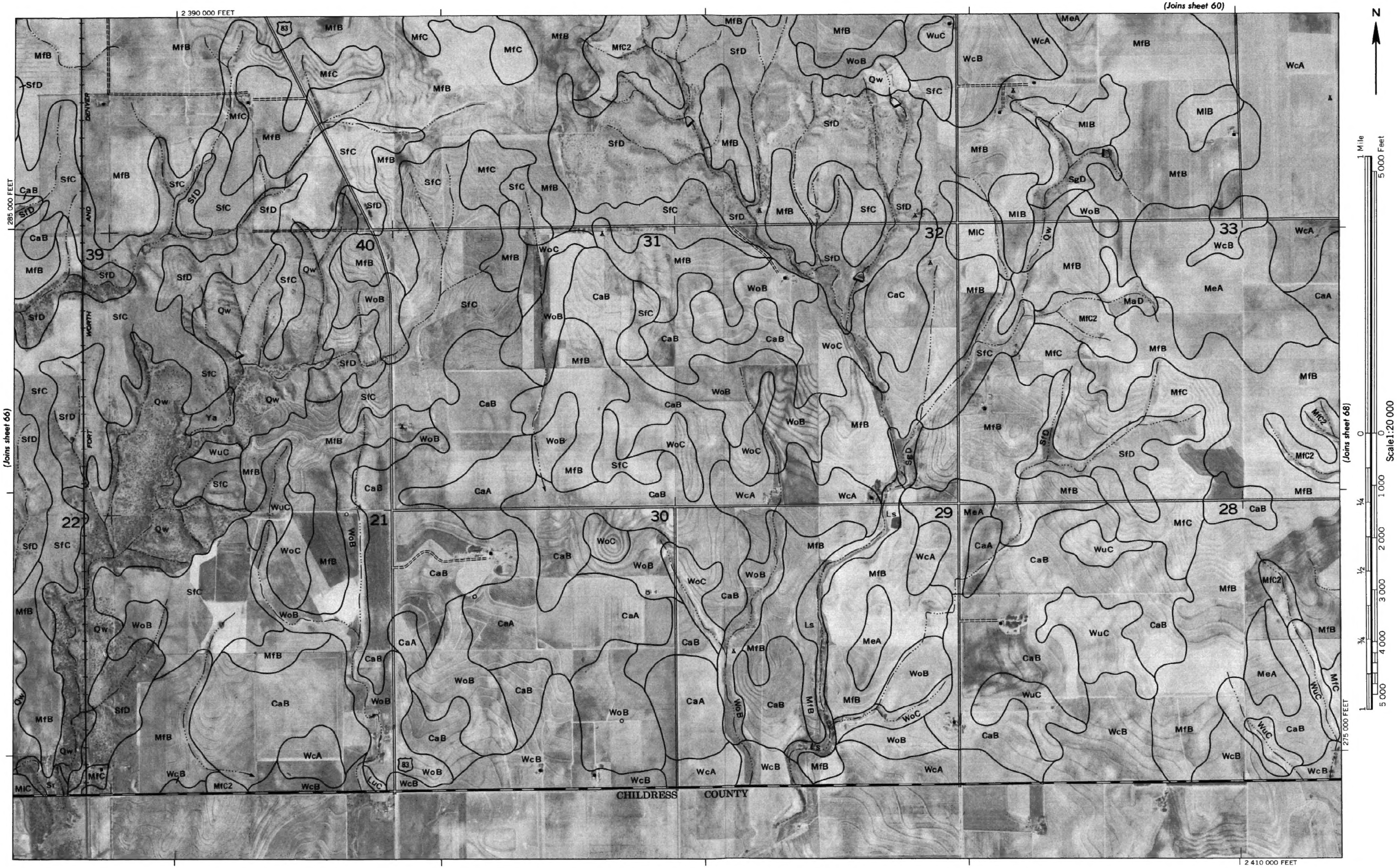


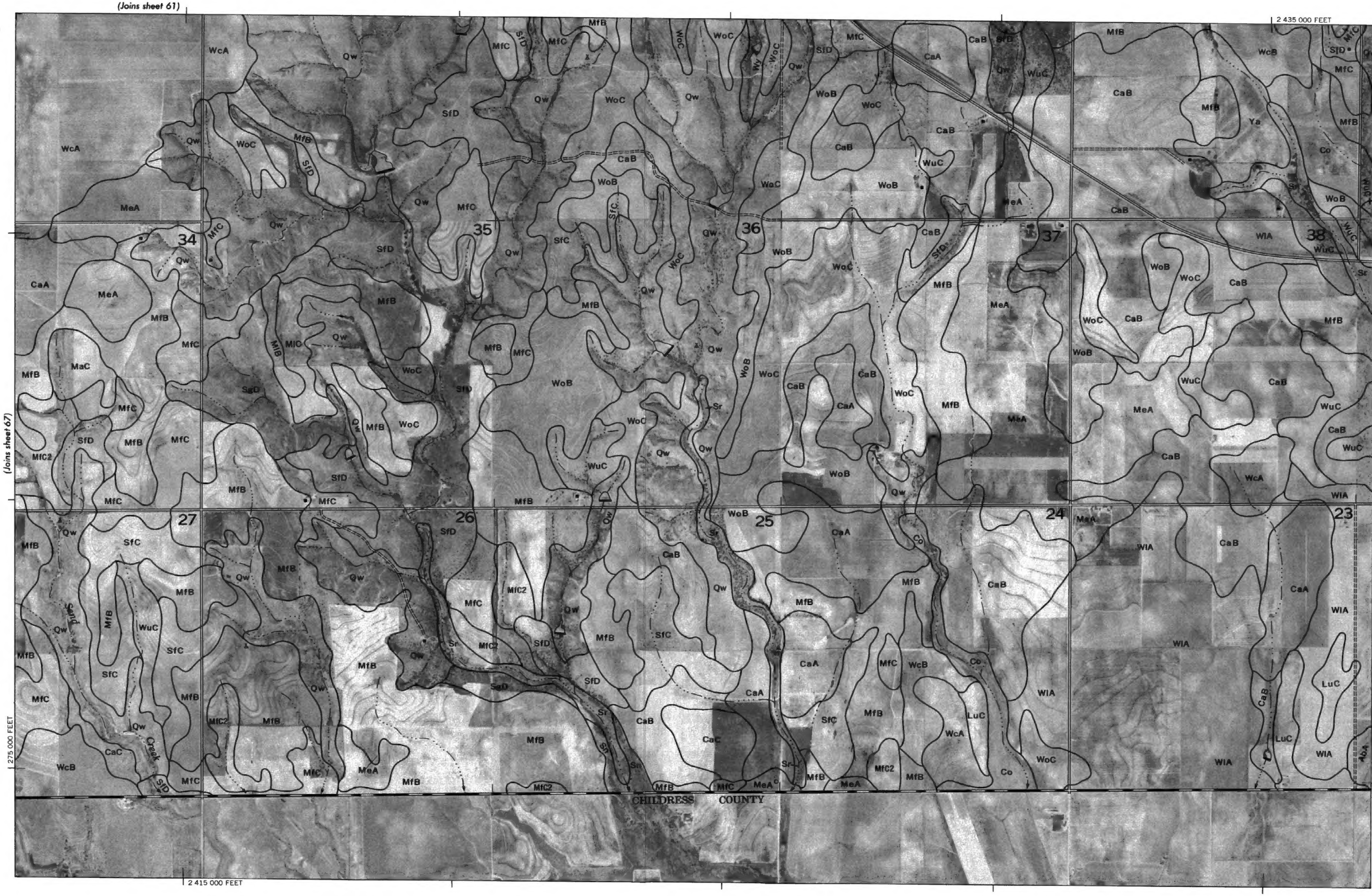
N

Scale 1:20 000

1 Mile 5 000 Feet

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000



Land division corners are approximately positioned on this map.

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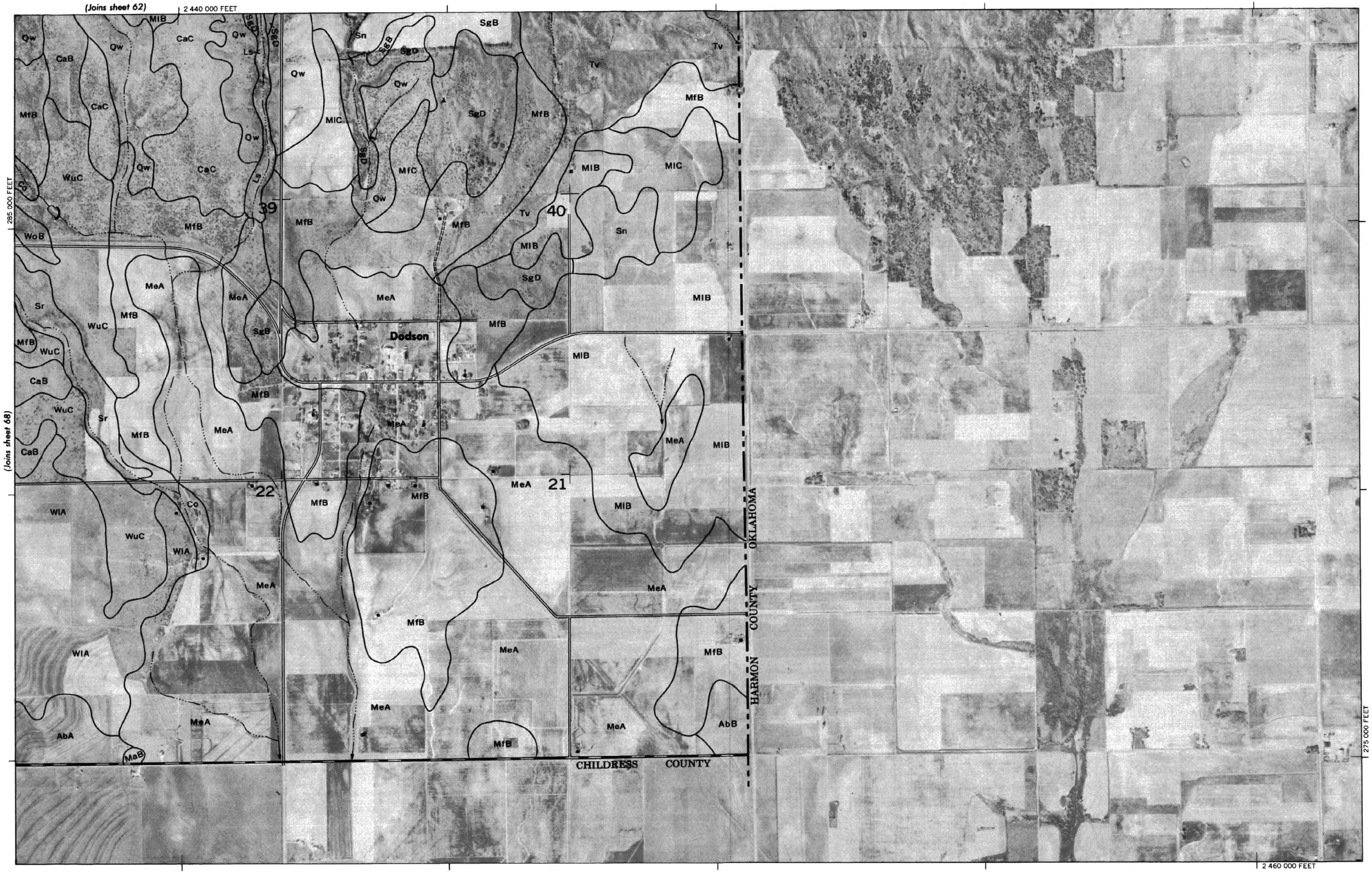

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